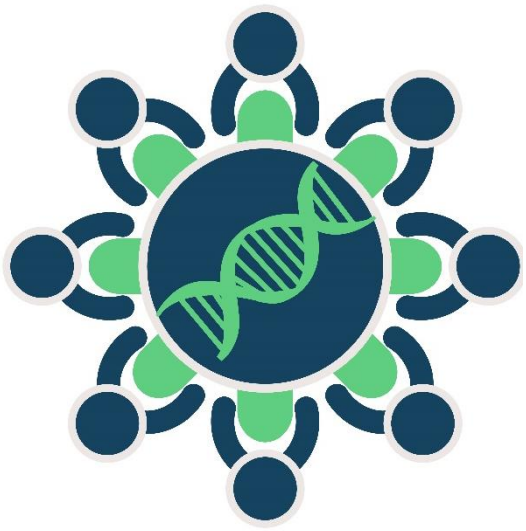

Bio League 2024 Syllable

Content

Biochemistry and Cell Biology

Studying Area	***Main concepts***
Organic chemistry	○ Hydrocarbons ○ Isomerism ○ Chemical groups and functional groups
Biochemistry	○ Polymers vs monomers ○ Carbohydrates ○ Lipids ○ Proteins ○ Nucleic acid ○ Vitamins ○ Hormones and their functions.
Cell Biology	○ Eukaryotes vs prokaryotes ○ Cell structures, functions, and types. (e.g., muscle cells, neurons, epithelial cells, or STEM cells) ○ Organelles and their abundance in specific cell types ○ Cytoskeleton, cellular junction, and extracellular matrix ○ Cell membrane structure and function: ▯ Passive vs active transport ▯ Exocytosis vs endocytosis ○ Cell communication: ▯ Signal reception ▯ Signal transduction ▯ Cellular response ▯ Cell apoptosis ○ Cell cycle ○ Mitosis
Molecular Biology	○ Metabolism: ▯ Exergonic vs endergonic reactions ▯ Enzymes: ▪ Structure and function ▪ Enzyme activity and regulation ▪ Factors affecting enzyme activity. ▯ Metabolic pathways: ▪ Cellular respiration ▪ Photosynthesis ▪ Fatty acid oxidation/synthesis ▪ HMP shunt (pentose pathway) ○ Protein synthesis ○ Role of proteins in DNA replication

Genetics and Evolution

Studying Area	***Main concepts***
Mendelian Genetics:	○ Law of segregation ○ Law of independent assortment ○ Punnett squares and probability calculations ○ Degrees of Dominance: ○ Codominance vs incomplete dominance vs complete dominance ○ ABO blood groups in humans ○ Pleiotropy ○ Epistasis ○ Polygenic Inheritance ○ Pedigree analysis ○ Amniocentesis vs Chorionic villus sampling (CVS) ○ Autosomal vs sex-linked inheritance ○ Genetic recombination and linkage ○ Genetic disorders caused by an alteration in chromosome number or structure.
Chromosomes and Meiosis:	○ Phases of meiosis (prophase, metaphase, anaphase, telophase) ○ Chromosome behavior during meiosis ○ Crossing over
DNA Replication and Protein Synthesis:	○ DNA structure ○ DNA replication process ○ Gene expression ○ Gene regulation ○ Genetic engineering techniques ○ Gene mutation types
Evolution and Natural Selection:	○ Darwin's theory of evolution ○ Natural selection and adaptation ○ Speciation and gene flow ○ Patterns of evolution
Population Genetics:	○ Allele frequencies and Hardy-Weinberg equilibrium ○ Genetic drift and gene flow ○ Population genetic variation ○ Genetic relationships and relatedness

Anatomy and physiology

Studying Area	***Main concepts***
Anatomical positions and planes	
Hemostasis	○ feedback mechanism ○ thermoregulation in living organism's body
Tissues:	○ Epithelial tissue: ▯ Structure and function ▯ Classification ○ Connective tissue: ▯ Structure and function ▯ Classification ○ Muscle tissue: ▯ Skeletal muscle tissue ▯ Cardiac muscle tissue ▯ Smooth muscle tissue
Respiratory system:	○ Overview of breathing in different living organisms (aquatic animals, tracheal system in insects) ○ Upper respiratory system (nose, nasal cavity, and pharynx) ○ Lower respiratory system (larynx) ○ Trachea ○ Lungs: ○ mechanism of gas exchange.
Digestive system:	○ Digestion in the oral cavity ○ Digestion in the stomach ○ Role of pancreas and lever in the digestion process ○ Digestion in the small intestine ○ Digestion in the large intestine ○ Feedback circuits regulating digestion
Nervous system:	○ Structure and function of neurons and glial cells ○ Mechanism of nerve impulse transmission: ☐ Action potential ☐ Synapses ☐ neurotransmitters ○ Sensory system: ☐ Mechanoreceptors (touch and pressure) ☐ Auditory system ☐ Vision ☐ Chemoreception (taste and smell) ○ Spinal control of movement: ☐ Lower motor neurons ☐ Muscle fiber structure ☐ Molecular basis of muscle contraction ☐ Spinal control of motor units: ▪ Stretch reflex ▪ Gamma motor neurons ▪ Golgi tendon organs

	▪ Spinal interneurons o Common neural disorders.
Cardiovascular system:	o Open vs closed circulatory systems o Organization of the circulatory system in the body o Mammalian circulation o Cardiac cycle o Electrocardiogram (EKG) o Blood vessel structure and function o Vasodilation vs vasoconstriction o Blood pressure o Capillary function
Osmoregulation and excretion:	o Osmosis and osmolarity o Osmoregulation mechanism and energetics o Forms of nitrogenous waste o Urinary system: ▪ Kidney Structure ▪ Nephron organization ▪ urine formation and blood filtration. ▪ Hormonal circuits in the kidney
Reproduction	o Male reproductive system o Female reproductive system o Ovarian and menstrual cycles o Pregnancy
Embryology:	o Early embryonic development, formation of germ layers, organogenesis. o Fetal development: Development of major organ systems during fetal development. o Developmental anomalies: Common developmental anomalies and their effects on anatomy.
Endocrine system:	o Intercellular communication o Three classes of hormones: ▪ Polypeptides ▪ Steroids ▪ Amines o Endocrine tissues and organs: ▪ hypothalamus ▪ Thyroid gland • Anatomy and physiology ▪ Pituitary gland ▪ Adrenal glands • Anatomy and physiology ▪ pancreas ▪ Testes ▪ ovaries o Feedback regulation in hormonal pathways o parathyroid hormone and vitamin D o Adrenal hormone and response to stress o Sex hormones

	○ Hormones and Biological Rhythms
Immune system:	○ Innate immunity ○ Adaptive immunity

Ecology and ethology

Studying Area	***Main concepts***
Responses to the Environment	○ Overview: Animal behaviors ○ Innate animal behaviors ○ Learnt animal behaviors. ○ Animal communication
Energy flow through ecosystems	○ Metabolic rates ○ Endotherms and Ectotherms ○ Temperature regulation strategies ○ Flow of energy and matter through ecosystems ○ Food chains and food webs ○ Impact of changes to trophic pyramids
Population ecology	○ Exponential and logistic growth in populations ○ Population regulation ○ Birth and death rates
Community ecology	○ Interactions between populations ○ Interactions among communities ○ Niches and competitions ○ Predator-Prey cycle ○ Community structure ○ Simpson's index of diversity
Biodiversity	○ Ecosystems and ecological networking ○ Tropical rainforest micro- and macro-diversity
Disruptions to ecosystems	○ Mutations as a variation source ○ Invasive species ○ Human activities threat to biodiversity ○ Climate change

List of resources

Cell biology and biochemistry	• Campbell Biology, 12th Edition (Lisa A. Urry, Micheal L. Cain etc.) • Kenneth A. Mason, Jonathan B. Losos & Susan R. Singer - Biology, 9th Edition (2010, McGraw-Hill) • Medical Biochemistry by John W. Baynes, Marek H. Dominiczak • Alberts' Molecular Biology of the Cell
Anatomy and physiology:	• Kenneth A. Mason, Jonathan B. Losos & Susan R. Singer - Biology, 9th Edition (2010, McGraw-Hill) • Bear, Mark F._ Connors, Barry W._ Paradiso, Michael A. - Neuroscience_ exploringthe brain-Wolters Kluwer (2016) • Human Anatomy by Frederic H. Martini, Robert B. Tallitsch, Judi L. Nath. • Vander's Human Physiology
Genetics and evolution:	• Campbell Biology, 12th Edition (Lisa A. Urry, Micheal L. Cain etc.) • Kenneth A. Mason, Jonathan B. Losos & Susan R. Singer - Biology, 9th Edition (2010, McGraw-Hill) • Essential Genetics and Genomics (7th Edition) • Medical Genetics- an Integrated Approach (McGraw-Hill, 2014)
Ecology:	• Campbell Biology, 12th Edition (Lisa A. Urry, Micheal L. Cain etc.) • Kenneth A. Mason, Jonathan B. Losos & Susan R. Singer - Biology, 9th Edition (2010, McGraw-Hill)