

Biology outline/syllabus

Unit 1(a) “science skills”

- A. Scientific Method
 1. Observe/infer/question
 2. Sample, organize data, hypothesize, predict
 3. Measurement and data collection (SI, base units)
 4. Graphing and analyzing (dimensional analysis)
 5. Models/Theories/Laws
 6. Experimental design (controls/variables)
 7. Communication/validation
- B. Lab skills
 1. Lab safety rules
 2. Equipment identification
 3. Equipment use (measurement)
 4. Cooperation/responsibility
- C. Microscopy
 1. Types & uses of microscopes
 2. ID parts of light microscope
 3. Magnification/resolution
 4. Microscopic measurements

Unit 1 (b) “Themes of Biology”

- A. Characteristics of life
 - 1) cells 2) organization 3) growth 4) energy use 5) growth/reproduction
- B. Structure & function
 - 1) uni/multi cellular 2) differentiation
- C. Stability & Homeostasis
- D. Reproduction & inheritance
 - 1) sexual/asexual reproduction
 - 2) Intro DNA, RNA, genes
- E. Evolution
 - 1) Natural selection
 - 2) Theories
 - 3) Genetic equilibrium
 - 4) Population/speciation
 - 5) Classification/taxonomy
- F. Interdependence
 - 1) Ecology - communities
 - 2) Cycles - water, O₂, CO₂, N
 - 3) Spheres – Bio, Litho, Hydro, Atmosphere
- G. Matter, Energy, Organization
 - 1) Heterotroph/autotroph
 - 2) Photosynthesis/respiration
 - 3) Pyramids

Unit 2 “Basic Chemistry”

- A. Composition of matter
 - 1) Matter/mass/weight
 - 2) Atoms – subatomic particles
 - 3) Element/molecule/compound
 - 4) Intro to periodic table – ID Bio elements
- B. Energy
 - 1) Kinetic/potential/free energy
 - 2) States of matter
 - 3) Reactants/Products
 - 4) Endergonic/exergonic
 - 5) Enzymes/activation energy & reading curves
 - 6) REDOX reactions
- C. Solutions
 - 1) Solute/solvent
 - 2) Concentration/saturation
 - 3) Acids/bases & buffers
 - 4) pHscale

Unit 3 “Biochemistry”

- A. Water
 - 1) Atomic structure/polarity
 - 2) Hydrogen bond
 - 3) Cohesion/adhesion
 - 4) Temperature moderation
- B. Carbon compounds
 - 1) Functional groups/structures/bonding
 - 2) Large carbon compounds
 - a) monomer/polymer/macromolecules
 - b) condensation/hydrolysis reactions
 - c) energy currency (ATP/ADP)
- C. Molecules of life
 - 1) Carbohydrates
 - a) monosaccharides/di/poly/
 - b) high energy in repeated bonds
 - 2) Proteins
 - a) nitrogen – functional group
 - b) amino acids – peptide bonds
 - c) enzymes/substrates
 - 3) Lipids
 - a) fatty acids/sterol group/complex /wax /stored energy
 - b) hydrophilic/hydrophobic
 - 4) Nucleic Acids
 - a) contain information
 - b) sugar/phosphate/nitrogen
 - c) DNA/RNA

Unit 4 “Introduction to the Cell”

- A. Discovery of the cell
 - 1) Hooke/Leevenhoek/Schleiden/Schwann/Virchow
 - 2) Cell Theory
- B. Cell Diversity
 - 1) size – surface area:volume ratio
 - 2) shape
 - 3) internal organization (organelles)
 - 4) prokaryote/eukaryote
- C. Parts of a Eukaryotic Cell
 - 1) Membranes
 - a) fluid mosaic model
 - b) proteins(periph/integral)
 - c) function to contain/separate
 - 2) Organelles
 - a) Mitochondrion – energy
 - b) Ribosomes – synthesize protein
 - c) ER – smooth/rough
 - d) Golgi apparatus – packaging
 - e) Lysosome-digesting
 - f) Microfilament/microtubule-support/movement
 - g) Cilia/flagella-movement
 - h) Nucleus – store info. Make RNA & ribosomes
 - i) Cell wall – plants
 - j) Vacuole – store enzyme & waste
 - k) Plastid – store food & pigment
 - 3) Multicellular organization
 - a) cell-tissue-organ-system-organism-species-population-community
 - b) colonial organisms

Unit 5 “Homeostasis & Transport”

- A. Passive Transport – without energy
 - 1) Diffusion – equilibrium
 - 2) Osmosis – membranes
 - a) hypotonic/hypertonic
 - b) concentration gradient
 - c) contractile vacuoles/plasmolysis/turgor pressure
 - 3) Facilitated Diffusion – carrier proteins
 - 4) Ion Channels – gates/ stresses
- B. Active Transport – uses energy
 - 1) Cell membrane pumps
 - 2) Na/K pump
 - 3) Require energy/against conc gradient
- C. Endocytosis/exocytosis

Unit 6 “Photosynthesis

- A. Biochemical pathways
- B. Light – visible spectrum/wavelengths
 - 1) Absorption/reflection
 - 2) Pigments
 - 3) Chloroplasts - function
- C. Electron Transport
 - 1) Photosystem I, photosystem II
 - 2) Electron acceptors
 - 3) Chemiosmosis - energy
 - 4) Water as electrons & protons
- D. Calvin Cycle
 - 1) Carbon Fixation – RuBP, PGA, PGAL
 - 2) Plant uses CO₂ to make Carbohydrates
- E. Alternative Pathways
 - 1) C₃ – stomata
 - 2) C₄ – stomata partially closed
 - 3) CAM – dry climate – Stomata closed during day

Unit 7 “Cellular Respiration”

- A. Glycolysis – cellular
 - 1) Break 6-c to 3-c cpd.
 - 2) Release 2ATP make Pyruvic Acid
 - 3) Reduce NAD⁺ to NADH
 - 4) 3.5% efficient
- B. Fermentation (anaerobic)
 - 1) Lactic Acid
 - 2) Alcoholic
- C. Aerobic Respiration (with O₂)
 - 1) Krebs’s Cycle – Citric Acid Cycle
 - 2) Generate energy from Carbon compounds
 - 3) Oxaloacetic Acid – regenerates
 - 4) Electron transport chain
 - 5) Oxygen – final electron acceptor
 - 6) 66% efficient

Unit 8 “Cell Reproduction”

- A. Chromosomes
 - 1) structure/chromatid/centromere
 - 2) Number – autosome/sex chromosome
 - 3) Homologous chrom./diploid/haploid
- B. Cell Division in Prokaryotes – binary fission
- C. Cell division in Eukaryotes –
 - 1) Cell cycle – interphase M,S,G₁,G₂,G₀
 - 2) Mitosis – autosomes
 - a) PMAT - cytokinesis
 - b) Chromosome number

3. Meiosis – sex chromosomes
 - a) M1 – PMAT1
 - b) genetic recombination/independent assortment
 - c) gametogenesis – $2n$ to $1n$
 - d) M2 – PMAT
 - e) Sexual/asexual reproduction
4. Chromosome abnormalities
 - a) syndromes
 - b) x linked
 - c) twins
 - d) abnormalities of cell cycle – cancer

Unit 9 “Fundamentals of Genetics”

A. Mendel’s Legacy

- 1) History
- 2) Pisum sativum experimental methods
- 3) Mendel’s crosses and results
- 4) P1, F1, F2
- 5) Mendel’s conclusions
 - a) Law of Dominant Recessive
 - b) Law of Independent Assortment
 - c) Law of Segregation
- 6) Molecular Genetics – alleles

B. Genetic Crosses

- 1) Genotype/phenotype
- 2) Probability
- 3) Homozygous/Heterozygous
- 4) Punnett squares
- 5) Predicting Monohybrid crosses
- 6) Predicting Dihybrid crosses
- 7) Incomplete dominance/co-dominance

Unit 10 “Protein Synthesis”

A. DNA

- 1) History
- 2) Structure –sugar, phosphate, nitrogen group
- 3) AGCT (U) – bases
- 4) Double Helix
- 5) Complimentary base pairing
- 6) Replication of DNA
- 7) Accuracy & repair

B. RNA

- 1) Structure
- 2) Types – messenger, transfer, ribosomal
- 3) Steps of Transcription

- C. Protein Synthesis
 - 1) Structure of proteins
 - 2) Genetic Code
 - a) codons b) amino acids c) protein
 - 3) Steps of Translation
 - a) tRNA/anticodons
 - b) ribosomes
 - 4) Protein assembly

Unit 11 “Gene Expression”

- A. History
- B. Role of gene expression – Genome
- C. Prokaryote – lac operon E. coli
- D. Structural Genes/promoter/operator
- E. Repression - regulator
- F. Activation – inducer
- G. Eukaryote expression
 - 1) intron/extron
 - 2) control/enhancer control/transcription factors
- H. Gene expression & development
 - 1) differentiation/morphogenesis
 - 2) homeotic genes
- I Cancer
 - 1) Tumor/benign/malignant
 - 2) Kinds of Cancer (omas)
 - 3) Cancer/cell cycle
 - 4) Causes of cancer
 - 5) Oncogenes / viruses

Unit 12 “Inheritance patterns and Human Genetics”

- A. Chromosomes and Inheritance
 - 1) Sex determination
 - 2) Linkage groups
 - 3) Chromosome mapping
 - 4) Mutations
 - 5) Diseases
- C. Human Genetics
 - 1) Pedigree analysis
 - 2) Trait & disorders
 - a) single allele b) multiple allele c) polygenic d) X- linked
 - e) nondisjunction
 - 3) Genetic sampling/counseling

Unit 13 “DNA Technology”

- A. Manipulating genes – practical uses
 - 1) Cloning – DNA fingerprints
 - 2) transplanting (isolate, recombinant DNA)

Unit 14 “Body Systems”

(project based topics)

- A. The Body Plan & comparative vertebrates
- B. Structure & function & homeostasis
- C. Integumentary
- D. Skeletal
- E. Muscular
- F. Circulatory
- G. Respiratory
- H. Digestive
- I. Excretory
- J. Nervous/sense organs
- K. Endocrine
- L. Reproductive (embryology)
- M. Immune – Infectious disease

Unit 15 “Plants”

- A. Basic plant structures & functions
- B. Tree observations and identifications
- C. Planting vegetables / class tree

Unit 16 “Pig Dissection”

- A. Dissection of fetal pig
- B. Study structures related to systems projects
- C. Notice similarities of structures to humans
- D. Independent investigations
- E. Pig Journal