

## Ch 1. Atomic Structure

- ♥ Early Atomic Theory: Dalton, Thomson, Rutherford and Millikan
- ♥ What Are Elements?
- ♥ Atomic Number and Mass Number
- ♥ The Periodic Table: Properties of Groups and Periods
- ♥ Ionic Bonds: Definitions and Examples
- ♥ Polar and Nonpolar Covalent Bonds: Definitions and Examples
- ♥ Covalent Bonding and Electron Shells: Definitions, Relationship & the Octet Rule
- ♥ Chemical Bonds IV: Hydrogen
- ♥ The Electron Shell
- ♥ Using Atoms and Ions to Determine Molecular Formulas

## Ch 2. Properties of Matter

- ♥ Matter: Physical and Chemical Properties
- ♥ States of Matter: Solids, Liquids, Gases, & Plasma
- ♥ Phase Change: Evaporation, Condensation, Freezing, Melting, Sublimation & Deposition
- ♥ Common Chemical Reactions and Energy Change
- ♥ Chemical Reactions and Balancing Chemical Equations
- ♥ Avogadro's Number: Using the Mole to Count Atoms
- ♥ Mole-to-Mole Ratios and Calculations of a Chemical Equation
- ♥ Nuclear Reaction: Definition & Examples
- ♥ Half-life: Calculating Radioactive Decay and Interpreting Decay Graphs
- ♥ Endothermic and Exothermic Reactions

## Ch 3. Fundamentals of Thermodynamics

- ♥ What is Energy? Definition and Significance in Nature
- ♥ Kinetic Energy to Potential Energy: Relationship in Different Energy Types
- ♥ First Law of Thermodynamics: Law of Conservation of Energy
- ♥ Second Law of Thermodynamics: Entropy and Systems
- ♥ What is Mechanical Energy? Definition & Examples
- ♥ What is Thermal Energy? Definition & Examples
- ♥ What is Radiant Energy? Definition & Examples
- ♥ What is Chemical Energy? Definition & Examples
- ♥ What is Electrical Energy? Definition & Examples
- ♥ What is Nuclear Energy? Definition & Examples
- ♥ How to Calculate Specific Heat Capacity for Different Substances
- ♥ Changes in Heat and Energy Diagrams
- ♥ Energy and Life: The Transformation of Energy in Living Organisms

## Ch 4. Mechanics

- ♥ Speed and Velocity: Concepts and Formulas
- ♥ What is Acceleration? Definition and Formula
- ♥ Implications of Mechanics on Objects

- ♥ Newton's First Law of Motion: Examples of the Effect of Force on Motion
- ♥ Newton's Second Law of Motion: The Relationship Between Force and Acceleration
- ♥ Newton's Third Law of Motion: Examples of the Relationship Between Two Forces
- ♥ Newton's Laws and Weight, Mass & Gravity

## Ch 5. Relativity

- ♥ Classical Relativity: Distance and Time Relation to the Observer
- ♥ Light and Relativity: Breakdown of Classical Relativity with Light Example
- ♥ Time Dilation: Description, Explanation & Examples
- ♥ Space Contraction: Shortening Distance for Fast Moving Objects
- ♥ Mass and Energy: Description and Interchangeable Relationship
- ♥ General and Special Relativity: Theory and Examples

## Ch 6. Electricity

- ♥ Electric Charge and Force: Definition, Repulsion & Attraction
- ♥ Electric Force Fields and the Significance of Arrow Direction & Spacing
- ♥ Coulomb's Law: Variables Affecting the Force Between Two Charged Particles
- ♥ Electric Potential: Charge Collections and Volt Unit
- ♥ Insulators and Conductors: Examples, Definitions & Qualities
- ♥ Voltage Sources: Energy Conversion and Examples
- ♥ What is Electric Current? Definition, Unit & Types
- ♥ Electrical Resistance: Definition, Unit & Variables
- ♥ Ohm's Law: Definition & Relationship Between Voltage, Current & Resistance
- ♥ Electric Circuit Fundamentals: Components & Types
- ♥ What is Electric Power?

## Ch 7. Magnetism

- ♥ Magnetic Force: Definition, Poles & Dipoles
- ♥ What is a Magnetic Field?
- ♥ How Magnetic Fields Are Created
- ♥ How Magnetic Forces Affect Moving Charges
- ♥ Electromagnetic Induction: Definition & Variables that Affect Induction
- ♥ Electromagnetic Induction: Conductor to Conductor & Transformers

## Ch 8. Waves, Sound, and Light

- ♥ Vibrations and Waves: Energy and Motion
- ♥ Wave Parameters: Wavelength, Amplitude, Period, Frequency & Speed
- ♥ Transverse & Longitudinal Waves: Definition & Examples
- ♥ What is Sound? Definition and Factors Affecting the Speed of Sound
- ♥ Pitch and Volume in Sound Waves
- ♥ Electromagnetic Waves: Definition, Sources & Properties
- ♥ The Major Regions of the Electromagnetic Spectrum
- ♥ The Nature of Light: Origin, Spectrum & Color Frequency
- ♥ Reflection: Angle of Incidence and Curved Surfaces

- ♥ Diffuse Reflection: Definition, Examples & Surfaces
- ♥ Resonance: Definition & Transmission of Waves
- ♥ Transparent and Opaque Materials in Electromagnetic Waves
- ♥ Color: White Light, Reflection & Absorption
- ♥ Refraction & Dispersion: Definition, Snell's Law & Index of Refraction
- ♥ Diffraction: Relation to Sound & Light and Effects of Wavelength
- ♥ Constructive and Destructive Interference
- ♥ The Doppler Effect: Definition, Examples & Applications
- ♥ Wave-Particle Duality: Concept, Explanation & Examples

## Ch 9. The Universe

- ♥ Origins of the Universe: The Big Bang and Expanding & Contracting Universes
- ♥ Evidence for the Big Bang Theory: Background Radiation, Red-Shift and Expansion
- ♥ Star Formation: Main Sequence, Dwarf & Giant Stars
- ♥ Types of Telescopes: Radio, Reflecting & Refracting Telescopes
- ♥ Galaxy Formation: Spiral, Elliptical & Irregular Galaxies
- ♥ Types of Stars by Size, Color and Life Cycle
- ♥ Structure of the Sun
- ♥ Stages of the Sun's Life Cycle
- ♥ Supernova and Supergiant Star Life Cycle
- ♥ Life Cycle of Neutron Stars
- ♥ Life Cycle of Black Holes
- ♥ Inner Planets of the Solar System: Mercury, Venus, Earth & Mars
- ♥ Formation of the Earth: Theories
- ♥ Formation of the Moon: Theories
- ♥ Planetary Predictors of Extraterrestrial Life
- ♥ Outer Planets of the Solar System: Jupiter, Saturn, Uranus, Neptune
- ♥ Dwarf Planets of the Solar System: Pluto, Eris, Haumea & Ceres
- ♥ Asteroids, Meteorites & Comets: Definitions and Characteristics

## Ch 10. Atmospheric Science

- ♥ The Dynamic Earth: Internal & External Forces that Shape Earth's Surface
- ♥ Temperature, Clouds, Wind & Humidity on the Atmospheric Cycle
- ♥ Natural Factors That Determine a Region's Climate
- ♥ Global Warming: Atmospheric Causes and Effect on Climate
- ♥ The Water Cycle: Precipitation, Condensation, and Evaporation
- ♥ Cycles of Matter: The Nitrogen Cycle and the Carbon Cycle

## Ch 11. Geology

- ♥ Effect of Erosion and Deposition on Landforms
- ♥ How a Landform Diagram Describes the Geological Progression of a Landscape
- ♥ Earthquakes and Volcanoes: Evidence of Earth's Inner Layers
- ♥ Rock Cycle: Igneous, Sedimentary, and Metamorphic Rocks
- ♥ Alfred Wegener's Theory of Continental Drift

- ♥ Evidence for the Mechanism of Continental Drift
- ♥ Plate Tectonics: A Unified Theory for Change of the Earth's Surface
- ♥ Causes of Tectonic Plate Movement
- ♥ Plate Boundaries: Convergent, Divergent, and Transform Boundaries

## Ch 12. Biomolecules

- ♥ Structure and Function of Carbohydrates
- ♥ Structure and Function of Lipids
- ♥ Proteins I: Structure and Function
- ♥ Proteins II: Amino Acids, Polymerization and Peptide Bonds
- ♥ Proteins III: Structure and Characteristics of the Amino Acids
- ♥ DNA: Chemical Structure of Nucleic Acids & Phosphodiester Bonds
- ♥ DNA: Adenine, Guanine, Cytosine, Thymine & Complementary Base Pairing
- ♥ DNA: Discovery, Facts, Structure & Function in Heredity
- ♥ Differences Between RNA and DNA & Types of RNA (mRNA, tRNA & rRNA)

## Ch 13. Biology of the Cell

- ♥ Osmosis, Diffusion and Saturation
- ♥ The Fluid Mosaic Model of the Cell Membrane
- ♥ How a Phospholipid Bilayer Is Both Hydrophobic and Hydrophilic
- ♥ Passive Transport in Cells: Simple and Facilitated Diffusion & Osmosis
- ♥ Active Transport in Cells: Definition & Examples
- ♥ Endocytosis and Exocytosis Across the Cell Membrane
- ♥ Structure of the Nucleus: Nucleolus, Nuclear Membrane, and Nuclear Pores
- ♥ The Ribosome: Structure, Function and Location
- ♥ The Endomembrane System: Functions & Components
- ♥ The Cytoskeleton: Microtubules and Microfilaments
- ♥ Mitochondria Structure: Cristae, Matrix and Inner & Outer Membrane
- ♥ Chloroplast Structure: Chlorophyll, Stroma, Thylakoid, and Grana
- ♥ Plant Cell Structures: The Cell Wall and Central Vacuole
- ♥ Eukaryotic and Prokaryotic Cells: Similarities and Differences
- ♥ Viruses: Bacteriophage Lytic and Lysogenic Cycles

## Ch 14. Biochemistry Foundations

- ♥ Function of Enzymes: Substrate, Active Site & Activation Energy
- ♥ Enzyme Activity & Inhibition: Structure, Substrates, pH & Temperature
- ♥ Coenzymes, Cofactors & Prosthetic Groups: Function and Interactions
- ♥ Enzymatic Reactions: Inhibition and Regulation
- ♥ Cellular Respiration: Energy Transfer in Cells
- ♥ Redox Reactions & Electron Carriers in Cellular Respiration: Definitions and Examples
- ♥ Glycolysis Pathway: Steps, Products & Importance
- ♥ The Citric Acid (Krebs) Cycle: Products and Steps
- ♥ The Electron Transport Chain: Products and Steps
- ♥ Lactic Acid & Alcoholic Fermentation: Comparison, Contrast & Examples

- ♥ Chlorophyll: Absorbing Light Energy for Photosynthesis
- ♥ Photolysis and the Light Reactions: Definitions, Steps, Reactants & Products
- ♥ Dark Reactions of Photosynthesis: The Calvin-Benson Cycle

## Ch 15. Chemical Nature of the Gene

- ♥ Protein Synthesis in the Cell and the Central Dogma
- ♥ Transcription of Messenger RNA (mRNA) from DNA
- ♥ RNA Processing in a Eukaryotic Cell: Splicing of Introns & Exons
- ♥ What Is the Genetic Code That Translates RNA Into Amino Acids?
- ♥ Making Sense of the Genetic Code: Codon Recognition
- ♥ Codon Recognition: How tRNA and Anticodons Interpret the Genetic Code
- ♥ The Role of Ribosomes and Peptide Bonds in Genetic Translation
- ♥ Translation of mRNA to Protein: Initiation, Elongation & Termination Steps
- ♥ What is a Point Mutation? Definition, Causes & Types
- ♥ Effects of Mutations on Protein Function: Missense, Nonsense, and Silent Mutations
- ♥ Effects of Frameshift Mutations: Definitions and Examples
- ♥ Mutagens: How the Environment Affects Mutation Rates

## Ch 16. Cell Processes

- ♥ Basic Genetics: The Genome & Chromosomes
- ♥ How is DNA Organized into Chromosomes? Structure & Function
- ♥ The Cell Cycle: Definition, Phases & Sequence
- ♥ Mitotic Spindle: Definition, Formation & Function
- ♥ Stages of Mitosis: Description & Sequence
- ♥ Cytokinesis: Animal Versus Plant Cells
- ♥ Asexual vs. Sexual Reproduction: Comparison & Characteristics
- ♥ Meiosis: Comparison to Mitosis, Crossing Over & Process
- ♥ Meiosis I Stages: Prophase I, Metaphase I, Anaphase I & Telophase I
- ♥ Meiosis II: Definition, Stages & Comparison to Meiosis I

## Ch 17. Introduction to Plant Biology

- ♥ Classification of Vascular, Nonvascular, Monocot & Dicot Plants
- ♥ Structure of Plant Stems: Vascular and Ground Tissue
- ♥ Apical Meristem & Primary Shoot System Growth
- ♥ Lateral Meristem & Secondary Shoot System Growth
- ♥ Structure of Leaves: The Epidermis, Palisade and Spongy Layers
- ♥ Primary Root Tissue, Root Hairs and the Plant Vascular Cylinder
- ♥ Root System Growth: The Root Cap, Primary Roots & Lateral Roots
- ♥ Flowers: Structure and Function of Male & Female Components
- ♥ Alternation of Generations: The Gametophyte and Sporophyte
- ♥ A Moss Life Cycle: Dominant Gametophyte
- ♥ A Fern Life Cycle: Plant Reproduction Without Flowers or Seeds
- ♥ A Gymnosperm Life Cycle: Reproduction of Plants with 'Naked Seeds'
- ♥ An Angiosperm Life Cycle: Flowering Plant Reproduction

- ♥ Asexual Plant Reproduction: Vegetative Propagation and Bulbs
- ♥ Tropisms: Phototropic, Geotropic and Thigmotropic Plant Growth
- ♥ Seasonal Growth Cycles: Perennial, Annual and Biennial Plants

## Ch 18. Human Anatomy

- ♥ Multicellular Organisms, Tissues and Epithelium
- ♥ Types of Connective Tissue
- ♥ Skeletal System and Muscular System
- ♥ Axial Skeleton: Functions and Anatomy
- ♥ Appendicular Skeleton: Functions and Anatomy
- ♥ Muscle Contraction: Actin and Myosin Bonding
- ♥ What Is the Muscular System? Function & How Muscles Work in Groups
- ♥ Muscular Function and Anatomy of the Arms: Major Muscle Groups
- ♥ Muscular Function and Anatomy of the Upper Leg
- ♥ Muscular Function and Anatomy of the Lower Leg and Foot
- ♥ Function & Anatomy of the Muscles of the Chest and Abdomen
- ♥ Function & Anatomy of the Muscles of the Face, Neck & Back
- ♥ Homologous Structures: Comparison of Body Structures Across Species
- ♥ The Integumentary System: The Epidermal Layer
- ♥ The Integumentary System: The Dermal Layer
- ♥ The Integumentary System Accessory Structures: Hair
- ♥ The Integumentary System Accessory Structures: Nails
- ♥ The Integumentary System Accessory Structures: Glands
- ♥ Circulatory System I: Types of Circulatory Systems
- ♥ Circulatory System II: The Human Vascular System
- ♥ Circulatory System III: The Heart
- ♥ Circulatory System IV: Red Blood Cells
- ♥ Gas Exchange in the Human Respiratory System
- ♥ Digestive System I: The Upper Gastrointestinal Tract
- ♥ Digestive System II: The Lower Gastrointestinal Tract
- ♥ Excretory System
- ♥ Homeostasis and Temperature Regulation in Humans
- ♥ Functions of the Nervous System
- ♥ The Structure and Function of Neurons
- ♥ The Central and Peripheral Nervous Systems
- ♥ The Sympathetic and Parasympathetic Nervous Systems
- ♥ Brain Structures and Functions Part I
- ♥ The Cerebral Cortex: Brain Structures and Functions Part II
- ♥ Innate Immunity: Inflammation, Neutrophils & Natural Killer Cells
- ♥ Acquired Immunity: T Cells, B Cells and Antibodies
- ♥ Functions of the Lymphatic System

## Ch 19. Animal Reproduction, Growth and Development

- ♥ Overview of Animal Reproduction and Development
- ♥ Spermatogenesis: How the Male Reproductive System Produces Sperm

- ♥ Oogenesis: How the Female Reproductive System Produces Eggs
- ♥ Early Embryonic Development: The Morula and Blastula
- ♥ Embryo Implantation and Placenta Formation
- ♥ The Placenta and the Fetus: Structure and Function
- ♥ Amniotic Fluid, The Amnion, and the Yolk Sac

## Ch 20. Genetics

- ♥ Genetics: Heredity, Traits & Chromosomes
- ♥ Properties of Alleles
- ♥ Mendel's First Law: The Law of Segregation
- ♥ Application of Mendel's First Law
- ♥ Mendel's Second Law: The Law of Independent Assortment
- ♥ Mendel's Dihybrid Cross Example: Practice & Ratio
- ♥ Exceptions to Simple Dominance: Codominance and Incomplete Dominance
- ♥ Exceptions to Independent Assortment: Sex-Linked and Sex-Limited Traits
- ♥ Crossing Over & Gene Linkage: Definition, Importance & Results
- ♥ Human Genetics: Multifactorial Traits & Model Organisms

## Ch 21. Ecology

- ♥ The Environment, Levels of Ecology and Ecosystems
- ♥ Food Chains, Trophic Levels and Energy Flow in an Ecosystem
- ♥ Interspecific Competition, Competitive Exclusion & Niche Differentiation
- ♥ Predator/Prey Interactions, Camouflage, Mimicry & Warning Coloration
- ♥ Symbiotic Relationships: Mutualism, Commensalism & Parasitism
- ♥ Populations: Density, Survivorship and Life Histories
- ♥ Carrying Capacity, Migration & Dispersion
- ♥ Dispersal, Colonization, and Island Biogeography
- ♥ Conservation Biology, Habitat Fragmentation, and Metapopulations
- ♥ Ecological Succession: From Pioneer to Climax Communities

## Ch 22. Evolution: Theories and Principles

- ♥ Theories of Evolution: Lamarck vs. Darwin
- ♥ Hardy-Weinberg Equilibrium I: Overview
- ♥ Hardy-Weinberg Equilibrium II: The Equation
- ♥ Natural Selection & Adaptation: Definition, Theory & Examples
- ♥ Natural Selection: Definition, Types & Examples
- ♥ Speciation: Allopatric and Sympatric Speciation
- ♥ Prezygotic Reproductive Barriers & Speciation: Definition & Examples
- ♥ Postzygotic Reproductive Barriers: Definition & Examples

## Ch 23. The Origin and History of Life On Earth

- ♥ The Origin of Life on Earth: Theories and Explanations
- ♥ The History of Life on Earth: Timeline and Characteristics of Major Eras
- ♥ The Endosymbiosis Theory: Evolution of Cells

- ♥ Evolutionary Change: Definition and Forms

## Ch 24. Phylogeny and the Classification of Organisms

- ♥ Taxonomy: Classification and Naming of Living Things
- ♥ Cladograms and Phylogenetic Trees: Evolution Classifications
- ♥ The Evolution of Prokaryotes: Archaeobacteria and Eubacteria
- ♥ The Evolution of Protists: Importance & Evolutionary History
- ♥ The Evolution of Plants and Fungi: Characteristics & Evolutionary History
- ♥ The Evolution of Animals: Importance & Evolutionary History
- ♥ The Evolution of Humans: Characteristics & Evolutionary History

## Ch 25. Human and Social Biology

- ♥ Innate Behavior: Reflexes, Kineses and Taxes
- ♥ Learned Behavior: Imprinting, Habituation and Conditioning
- ♥ Learned Behavior: Imprinting, Habituation and Conditioning
- ♥ Social Behavior: The Cost-Benefit of Altruism and Kin Selection
- ♥ Social Systems vs. Individual Fitness: The Queen/Worker Relationship
- ♥ The Theory of Demographic Transition: Overview
- ♥ Carrying Capacity of a Population: Effect of Biomedical Progress