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Chapter 1: The Living World

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Diversity in the Living World	- What is Living?	- Defining Characteristics of Life	- Growth, Reproduction, Metabolism, Consciousness	Chapter 1, Page 4
		- Levels of Biological Organization	- Cellular, Tissue, Organ, Organ System, Organismal		Chapter 1, Page 5
		- Biodiversity	- Definition and Importance	- Variety of Species, Genetic Diversity, Ecosystem Diversity	Chapter 1, Page 6
		- Need for Classification	- Evolutionary Relationships	- Phylogenetics, Cladistics	Chapter 1, Page 7
2	Taxonomic Categories	- Species	- Basic Unit of Classification	- Biological Species Concept, Morphological Species Concept	Chapter 1, Page 8
		- Genus	- Group of Related Species	- Homo (Human), Panthera (Lion, Tiger)	Chapter 1, Page 8
		- Family	- Group of Related Genera	- Felidae (Cats), Hominidae (Humans)	Chapter 1, Page 9
		- Order	- Group of Related Families	- Carnivora (Cats, Dogs), Primates (Monkeys, Humans)	Chapter 1, Page 9
		- Class	- Group of Related Orders	- Mammalia (Mammals), Aves (Birds)	Chapter 1, Page 9
		- Phylum	- Group of Related Classes	- Chordata (Vertebrates), Arthropoda (Insects, Crustaceans)	Chapter 1, Page 9

		- Kingdom	- Highest Taxonomic Rank	- Plantae, Animalia, Fungi, Protista, Monera	Chapter 1, Page 10
3	Taxonomical Aids	- Herbarium	- Collection of Preserved Plant Specimens	- Methods of Preparation and Storage	Chapter 1, Page 11
		- Botanical Gardens	- Live Plant Collections	- Example: Royal Botanical Gardens, Kew	Chapter 1, Page 12
		- Museum	- Collection of Preserved Animal Specimens	- Types: Natural History, Science Museums	Chapter 1, Page 13
		- Zoological Parks	- Protected Areas for Living Animals	- Example: San Diego Zoo, London Zoo	Chapter 1, Page 14
		- Keys	- Identification of Organisms	- Dichotomous Key, Artificial Key	Chapter 1, Page 15

Chapter 2: Biological Classification

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Five Kingdom Classification	Monera	- Bacteria: Types	- Archaebacteria: Methanogens, Halophiles, Thermoacidophiles	Chapter 2, Page 19
			- Eubacteria: True Bacteria	- Cyanobacteria (Blue-green algae), Mycoplasma	Chapter 2, Page 20
			- Bacterial Structure	- Cell Wall, Plasma Membrane, Flagella, Pili, Ribosomes	Chapter 2, Page 21
			- Nutrition in Bacteria (Autotrophic, Heterotrophic)	- Photosynthetic Autotrophs, Chemosynthetic Autotrophs, Saprophytes, Parasites	Chapter 2, Page 22

			- Reproduction in Bacteria	- Binary Fission, Conjugation, Transformation, Transduction	Chapter 2, Page 23
		-Protista	- Chrysophytes	- Diatoms, Desmids	Chapter 2, Page 24
			- Dinoflagellates	- Gonyaulax, Red Tides	Chapter 2, Page 25
			- Euglenoids	- Euglena: Structure, Photosynthesis, Nutrition	Chapter 2, Page 26
			- Slime Molds	- Plasmodium stage, Fruiting bodies	Chapter 2, Page 27
			- Protozoans: Types	- Amoeboid: Amoeba, Entamoeba	Chapter 2, Page 28
				- Flagellated: Trypanosoma, Giardia	Chapter 2, Page 29
				- Ciliated: Paramecium	Chapter 2, Page 30
				- Sporozoans: Plasmodium, Life Cycle of Plasmodium	Chapter 2, Page 31
		Fungi	- Structure of Fungi	- Mycelium, Hyphae, Septa, Coenocytic hyphae	Chapter 2, Page 32
			- Reproduction in Fungi	- Vegetative: Fragmentation, Budding	Chapter 2, Page 33
				- Asexual: Spore Formation (Sporangiospores, Conidiospores)	Chapter 2, Page 34
				- Sexual: Plasmogamy, Karyogamy,	Chapter 2, Page 35

				Meiosis, Types of Spores	
			- Types of Fungi	- Phycomycetes: Rhizopus, Albugo	Chapter 2, Page 36
				- Ascomycetes: Penicillium, Aspergillus	Chapter 2, Page 37
				- Basidiomycetes: Agaricus, Puccinia	Chapter 2, Page 38
				- Deuteromycetes: Alternaria	Chapter 2, Page 39
		- Plantae	- Overview of Plant Kingdom	- Major Groups: Non-Vascular, Vascular	Chapter 2, Page 40
			- Major Groups of Plantae	- Algae: Chlorophyceae, Phaeophyceae, Rhodophyceae	Chapter 2, Page 41
				- Bryophytes: Liverworts, Mosses	Chapter 2, Page 42
				- Pteridophytes: Ferns, Horsetails	Chapter 2, Page 43
				- Gymnosperms: Pinus, Cycas	Chapter 2, Page 44
				- Angiosperms: Monocots, Dicots	Chapter 2, Page 45
		- Animalia	- Overview of Animal Kingdom - Classification Criteria in Animal Kingdom	- Multicellular, Eukaryotic	Chapter 2, Page 46
				- Levels of Organization, Symmetry, Body Plan, Coelom, Segmentation	Chapter 2, Page 47
2	Viruses, Viroids, and Lichens	- Viruses	- Structure of Viruses	- Capsid, Envelope, Genetic Material (DNA/RNA)	Chapter 2, Page 48
			- Types of Viruses	- Bacteriophage: T4 Phage Structure	Chapter 2, Page 49

				- Plant Viruses: Tobacco Mosaic Virus (TMV)	Chapter 2, Page 50
				- Animal Viruses: Influenza Virus, HIV	Chapter 2, Page 51
			- Reproduction in Viruses	- Lytic Cycle: Attachment, Penetration, Biosynthesis, Maturation, Lysis	Chapter 2, Page 52
				- Lysogenic Cycle: Prophage, Integration, Induction	Chapter 2, Page 53
		- Viroids	- Structure of Viroids	- Circular RNA, Lack of Protein Coat	Chapter 2, Page 54
		- Lichens	- Structure and Types of Lichens	- Crustose, Foliose, Fruticose	Chapter 2, Page 55
			- Role of Lichens as Bioindicators	- Pollution Indicators, Symbiotic Relationship	Chapter 2, Page 56

Chapter 3: Plant Kingdom

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Algae	- General Characteristics	- Thalloid, Aquatic, Autotrophic	- Occurrence: Freshwater, Marine, Moist soils, Rocks	Chapter 3, Page 27
		- Classification	- Chlorophyceae (Green Algae)	- Pigments: Chlorophyll a, b	Chapter 3, Page 29
			- Phaeophyceae (Brown Algae)	- Pigments: Chlorophyll a, c, Fucoxanthin	Chapter 3, Page 29

			- Rhodophyceae (Red Algae)	- Pigments: Chlorophyll a, d, Phycoerythrin	Chapter 3, Page 30
		- Reproduction	- Vegetative: Fragmentation	- Asexual: Spores (Zoospores, etc.)	Chapter 3, Page 28
			- Sexual: Isogamy, Anisogamy, Oogamy	- Examples: Ulothrix, Spirogyra, Volvox	Chapter 3, Page 28
2	Bryophytes	- General Characteristics	- Thallus-like or Erect Plant Body	- Found in moist, shaded areas, soil	Chapter 3, Page 31
		- Classification	- Liverworts	- Example: Marchantia	Chapter 3, Page 32
			- Mosses	- Example: Funaria, Sphagnum	Chapter 3, Page 33
		- Reproduction	- Gametophyte (Dominant Stage)	- Sporophyte attached to gametophyte	Chapter 3, Page 34
3	Pteridophytes	- General Characteristics	- First Vascular Plants	- Have true roots, stems, leaves	Chapter 3, Page 35
		- Classification	- Psilopsida	- Example: Psilotum	Chapter 3, Page 36
			- Lycopsida	- Example: Selaginella, Lycopodium	Chapter 3, Page 37
			- Sphenopsida	- Example: Equisetum	Chapter 3, Page 37
			- Pteropsida	- Example: Ferns (Pteris, Adiantum)	Chapter 3, Page 37
		- Reproduction	- Sporophyte (Dominant Stage)	- Requires water for fertilization	Chapter 3, Page 38
4	Gymnosperms	- General Characteristics	- Naked Seeds	- No ovary wall, seeds exposed	Chapter 3, Page 39
		- Classification	- Cycas	- Unbranched stem, pinnate leaves	Chapter 3, Page 40
			- Pinus	- Branched stem, needle-like leaves	Chapter 3, Page 40
			- Ginkgo	- Fan-shaped leaves	Chapter 3, Page 41

		- Reproduction	- Heterosporous	- Microspores, Megaspores	Chapter 3, Page 42
5	Angiosperms	- General Characteristics	- Flowering Plants	- Seeds enclosed within fruits	Chapter 3, Page 43
		- Classification	- Dicotyledons	- Two seed leaves, Reticulate venation	Chapter 3, Page 44
			- Monocotyledons	- Single seed leaf, Parallel venation	Chapter 3, Page 45
		- Reproduction	- Pollination	- Insect-pollinated, wind-pollinated	Chapter 3, Page 46

Chapter 4: Animal Kingdom

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Basis of Classification	Levels of Organisation	Cellular	No tissue formation	Chapter 4, Page 37
			Tissue	Group of cells	Chapter 4, Page 37
			Organ	Tissues grouped together	Chapter 4, Page 37
			Organ System	Organs working together	Chapter 4, Page 37
		Symmetry	Asymmetry	No symmetry	Chapter 4, Page 38
			Radial Symmetry	Body parts arranged around central axis	Chapter 4, Page 38
			Bilateral Symmetry	Body divided into two equal halves	Chapter 4, Page 38
		Diploblastic and Triploblastic Organisation	Diploblastic	Two Germ Layers: Ectoderm and Endoderm	Chapter 4, Page 39
			Triploblastic	Three Germ Layers: Ectoderm,	Chapter 4, Page 39

				Mesoderm, Endoderm	
		Coelom	Acoelomate	No body cavity	Chapter 4, Page 39
			Pseudocoelomate	Body cavity not fully lined with mesoderm	Chapter 4, Page 39
			Coelomate	Body cavity fully lined with mesoderm	Chapter 4, Page 39
		Segmentation	Metameric Segmentation	Body divided into segments	Chapter 4, Page 40
		Notochord	Chordates	Presence of Notochord	Chapter 4, Page 41
			Non-Chordates	Absence of Notochord	Chapter 4, Page 41
2	Classification of Animals	Non-Chordates	Porifera	Pore-bearing animals, mostly marine	Chapter 4, Page 42
			Coelenterata (Cnidaria)	Aquatic, radial symmetry, tentacles	Chapter 4, Page 43
			Ctenophora	Comb Jellies, marine	Chapter 4, Page 44
			Platyhelminthes	Flatworms, bilaterally symmetrical	Chapter 4, Page 45
			Aschelminthes	Roundworms, cylindrical	Chapter 4, Page 46
			Annelida	Segmented worms, bilateral symmetry	Chapter 4, Page 47
			Arthropoda	Jointed appendages, exoskeleton	Chapter 4, Page 48
			Mollusca	Soft body, usually with shell	Chapter 4, Page 49
			Echinodermata	Spiny-skinned, radial symmetry	Chapter 4, Page 50

			Hemichordata	Marine, worm-like	Chapter 4, Page 51
		Chordates	Urochordata	Notochord in larval tail	Chapter 4, Page 52
			Cephalochordata	Notochord extends from head to tail	Chapter 4, Page 53
			Vertebrata	Notochord replaced by vertebral column in adults	Chapter 4, Page 54

Chapter 5: Morphology of Flowering Plants

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	The Root	Types of Roots	Tap root system	Example: Mustard	Chapter 5, Page 58
			Fibrous root system	Example: Wheat	Chapter 5, Page 58
			Adventitious roots	Example: Monstera	Chapter 5, Page 58
		Regions of the Root	Root Cap	Protects root apex	Chapter 5, Page 59
			Region of Meristematic Activity	For cell division	Chapter 5, Page 59
			Region of Elongation	For growth	Chapter 5, Page 59
			Region of Maturation	Where root hairs develop	Chapter 5, Page 59
2	The Stem	Characteristics	Nodes and Internodes	Stem is the ascending part of the plant	Chapter 5, Page 60
			Buds	Green in young stage	Chapter 5, Page 60
			Support	Develops from plumule, supports	Chapter 5, Page 60

				branches, leaves, flowers	
		Modifications	Underground (Rhizome, Corm, Tubers)	Example: Ginger (Rhizome), Colocasia (Corm), Potato (Tuber)	Chapter 5, Page 61
			Aerial (Tendrils, Thorns)	Example: Bougainvillea (Thorns)	Chapter 5, Page 61
			Sub-aerial (Runners, Stolons)	Example: Strawberry (Runners)	Chapter 5, Page 61
3	The Leaf	Structure	Leaf base	Attaches to the stem	Chapter 5, Page 61
			Petiole	Supports the blade	Chapter 5, Page 61
			Lamina	The green expanded part	Chapter 5, Page 61
		Venation	Reticulate	Found in dicots	Chapter 5, Page 61
			Parallel	Found in monocots	Chapter 5, Page 61
		Modifications	Leaf tendrils	Example: Pea	Chapter 5, Page 62
			Spines	Example: Cactus	Chapter 5, Page 62
			Phyllode	Example: Acacia	Chapter 5, Page 62
4	Inflorescence	Types	Racemose	Example: Mustard	Chapter 5, Page 62
			Cymose	Example: Jasmine	Chapter 5, Page 62
5	The Flower	Parts	Calyx	Sepals, usually green	Chapter 5, Page 63
			Corolla	Petals, usually colorful	Chapter 5, Page 63
			Androecium	Stamens: Filament and Anther	Chapter 5, Page 63

			Gynoecium	Pistil: Ovary, Style, Stigma	Chapter 5, Page 63
6	The Fruit	Types	Simple	Example: Mango	Chapter 5, Page 64
			Aggregate	Example: Raspberry	Chapter 5, Page 64
			Multiple	Example: Pineapple	Chapter 5, Page 64
7	The Seed	Structure	Dicotyledonous	Example: Gram	Chapter 5, Page 65
			Monocotyledonous	Example: Maize	Chapter 5, Page 65

Chapter 6: Anatomy of Flowering Plants

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	The Tissue System	Epidermal Tissue System	Epidermis	Outermost layer of the plant body, usually single-layered	Chapter 6, Page 71
			Stomata	Structures in epidermis of leaves, regulate transpiration and gas exchange	Chapter 6, Page 71
			Trichomes	Epidermal hairs on the stem, prevent water loss	Chapter 6, Page 72
		Ground Tissue System	Parenchyma	Living cells, found in cortex, pith	Chapter 6, Page 72
			Collenchyma	Provides mechanical support, found in hypodermis	Chapter 6, Page 72
			Sclerenchyma	Dead cells, provides	Chapter 6, Page 72

				mechanical support	
		Vascular Tissue System	Xylem	Conducts water and minerals	Chapter 6, Page 73
			Phloem	Transports food and nutrients	Chapter 6, Page 73
2	Anatomy of Dicot and Monocot Plants	Dicot Root	Epiblema	Outermost layer of the root, with root hairs	Chapter 6, Page 74
			Cortex	Layer below epiblema, made of parenchyma cells	Chapter 6, Page 74
			Endodermis	Innermost layer of the cortex, has Casparian strips	Chapter 6, Page 74
			Pericycle	Layer just inside endodermis, gives rise to lateral roots	Chapter 6, Page 74
			Vascular bundles	Radial, xylem and phloem arranged in different radii	Chapter 6, Page 75
		Dicot Stem	Epidermis	Outermost protective layer	Chapter 6, Page 75
			Hypodermis	Made of collenchymatous cells	Chapter 6, Page 75
			Cortex	Below hypodermis, made of parenchyma	Chapter 6, Page 75
			Endodermis	Innermost layer of cortex, surrounds vascular bundles	Chapter 6, Page 75
			Vascular bundles	Conjoint, collateral, open, and endarch	Chapter 6, Page 75

			Pith	Central part, made of parenchyma cells	Chapter 6, Page 75
		Monocot Root	Epidermis	Outermost layer of the root	Chapter 6, Page 76
			Cortex	Large, made of parenchymatous cells	Chapter 6, Page 76
			Endodermis	Innermost layer of cortex, has Casparian strips	Chapter 6, Page 76
			Pericycle	Layer just inside endodermis	Chapter 6, Page 76
			Vascular bundles	More numerous, scattered	Chapter 6, Page 76
		Monocot Stem	Epidermis	Outermost layer of the stem	Chapter 6, Page 77
			Hypodermis	Made of sclerenchymatous cells	Chapter 6, Page 77
			Ground tissue	Not differentiated into cortex, pith	Chapter 6, Page 77
			Vascular bundles	Scattered, surrounded by sclerenchymatous bundle sheath	Chapter 6, Page 77
3	Secondary Growth	Vascular Cambium	Formation of cambium ring	Responsible for secondary growth	Chapter 6, Page 78
			Secondary Xylem and Phloem	Produced by vascular cambium	Chapter 6, Page 78
		Cork Cambium	Formation of cork (phellem) and secondary cortex (phelloderm)	Provides protection	Chapter 6, Page 79

Chapter 7: Structural Organisation in Animals

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Animal Tissues	Epithelial Tissue	Simple Epithelium	Single layer of cells, covers body surfaces	Chapter 7, Page 78
			Compound Epithelium	Multiple layers of cells, provides protection	Chapter 7, Page 78
			Squamous Epithelium	Thin, flat cells, found in alveoli of lungs	Chapter 7, Page 79
			Cuboidal Epithelium	Cube-shaped cells, found in kidney tubules	Chapter 7, Page 79
			Columnar Epithelium	Tall, column-like cells, found in the lining of intestines	Chapter 7, Page 79
			Ciliated Epithelium	Columnar cells with cilia, found in respiratory tract	Chapter 7, Page 79
		Connective Tissue	Loose Connective Tissue	Consists of cells, fibers, and ground substance	Chapter 7, Page 80
			Dense Connective Tissue	High density of fibers, forms tendons and ligaments	Chapter 7, Page 80
			Adipose Tissue	Stores fat, found under skin and around organs	Chapter 7, Page 80
			Skeletal Tissue	Bone and cartilage, provides support and structure	Chapter 7, Page 81
		Muscular Tissue	Skeletal Muscle	Voluntary muscles attached to bones	Chapter 7, Page 81
			Smooth Muscle	Involuntary muscles found in	Chapter 7, Page 81

				walls of internal organs	
			Cardiac Muscle	Found in the heart, involuntary, striated	Chapter 7, Page 81
		Nervous Tissue	Neurons	Nerve cells, conduct electrical impulses	Chapter 7, Page 82
			Neuroglia	Supporting cells in the nervous system	Chapter 7, Page 82
2	Organ and Organ Systems	Examples of Organ Systems	Digestive System	Organs: mouth, esophagus, stomach, intestines	Chapter 7, Page 83
			Respiratory System	Organs: nose, trachea, lungs	Chapter 7, Page 83
			Circulatory System	Organs: heart, blood vessels	Chapter 7, Page 83
			Nervous System	Organs: brain, spinal cord, nerves	Chapter 7, Page 83
3	Morphology and Anatomy	Earthworm	Morphology: segmented body	Segments with setae, clitellum, hermaphroditic	Chapter 7, Page 84
			Anatomy: digestive system	Complete digestive system, starts with mouth, ends with anus	Chapter 7, Page 84
		Cockroach	Morphology: segmented body	Body divided into head, thorax, abdomen	Chapter 7, Page 85
			Anatomy: nervous system	Consists of brain, nerve cord, ganglia	Chapter 7, Page 85
		Frog	Morphology: amphibious, moist skin	Body divided into head, trunk, no tail	Chapter 7, Page 86
			Anatomy: circulatory system	Three-chambered heart, closed circulation	Chapter 7, Page 86

Chapter 8: Cell - The Unit of Life

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Cell Theory	Historical Background	Contributions by Schleiden, Schwann, and Virchow	Schleiden (Plant cells), Schwann (Animal cells), Virchow (Cell division)	Chapter 8, Page 88
		Modern Understanding	All living organisms are composed of cells, all cells arise from pre-existing cells	Key principles of cell theory	Chapter 8, Page 88
2	Overview of Cell	Definition	Cell is the fundamental structural and functional unit of life	Cells are the basic units of life in all living organisms	Chapter 8, Page 88
		Types of Cells	Prokaryotic and Eukaryotic	Prokaryotic (No nucleus), Eukaryotic (Nucleus and organelles)	Chapter 8, Page 88
		Structure	Basic components of a cell	Plasma membrane, cytoplasm, and nucleus	Chapter 8, Page 88
3	Prokaryotic Cells	Characteristics	Small, lack membrane-bound organelles	DNA is not enclosed within a nucleus	Chapter 8, Page 90
		Cell Envelope	Complex structure with glycocalyx, cell wall, and plasma membrane	Protection and structural support	Chapter 8, Page 91
		Ribosomes	70S ribosomes, site of protein synthesis	Found in cytoplasm	Chapter 8, Page 91
		Inclusions	Reserve materials like phosphate granules, glycogen granules	Stored in cytoplasm	Chapter 8, Page 91
4	Eukaryotic Cells	Characteristics	Membrane-bound organelles, well-defined nucleus	Found in protists, plants, animals, fungi	Chapter 8, Page 92

		Cell Membrane	Phospholipid bilayer, fluid mosaic model	Semi-permeable, controls substance movement	Chapter 8, Page 93
		Cell Wall	Found in plants, algae, fungi	Provides shape, protection, and support	Chapter 8, Page 93
		Endomembrane System	Includes ER, Golgi complex, lysosomes, vacuoles	Coordinates various cellular functions	Chapter 8, Page 95
		Mitochondria	Powerhouse of the cell	Site of ATP production, double membrane structure	Chapter 8, Page 97
		Plastids	Chloroplasts (photosynthesis), chromoplasts, leucoplasts	Found in plant cells, responsible for photosynthesis and storage	Chapter 8, Page 97
		Ribosomes	80S ribosomes, site of protein synthesis	Found in cytoplasm and on rough ER	Chapter 8, Page 98
		Cytoskeleton	Network of protein fibers, includes microtubules, microfilaments, intermediate filaments	Provides structural support, aids in movement	Chapter 8, Page 99
		Cilia and Flagella	Hair-like structures	Involved in cell movement	Chapter 8, Page 99
		Nucleus	Contains genetic material (DNA)	Controls cell activities, site of RNA synthesis	Chapter 8, Page 100
		Chromosomes	Structures within the nucleus containing DNA	Involved in heredity and cell division	Chapter 8, Page 101
		Microbodies	Vesicles containing enzymes	Involved in various metabolic activities	Chapter 8, Page 102

Chapter 9: Biomolecules

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Chemical Composition	Analysis of Chemical Composition	Wet weight	Method to determine chemical composition in tissues	Chapter 9, Page 104
			Dry weight	Method to determine chemical composition in tissues	Chapter 9, Page 104
			Ash	Method to determine chemical composition in tissues	Chapter 9, Page 104
		Inorganic Elements	Carbon	Found in both living and non-living matter	Chapter 9, Page 104
			Hydrogen	Found in both living and non-living matter	Chapter 9, Page 104
			Oxygen	Found in both living and non-living matter	Chapter 9, Page 104
			Nitrogen	Found in both living and non-living matter	Chapter 9, Page 104
		Organic Compounds	Amino acids	Found in living organisms	Chapter 9, Page 104
			Sugars	Found in living organisms	Chapter 9, Page 104
			Fatty acids	Found in living organisms	Chapter 9, Page 104
			Nucleotides	Found in living organisms	Chapter 9, Page 104

2	Primary and Secondary Metabolites	Primary Metabolites	Amino acids	Directly involved in growth, development, reproduction	Chapter 9, Page 108
			Sugars	Directly involved in growth, development, reproduction	Chapter 9, Page 108
			Fatty acids	Directly involved in growth, development, reproduction	Chapter 9, Page 108
			Nucleotides	Directly involved in growth, development, reproduction	Chapter 9, Page 108
		Secondary Metabolites	Alkaloids	Not directly involved in normal growth, but have ecological importance	Chapter 9, Page 108
			Flavonoids	Not directly involved in normal growth, but have ecological importance	Chapter 9, Page 108
			Rubber	Not directly involved in normal growth, but have ecological importance	Chapter 9, Page 108
			Essential oils	Not directly involved in normal growth, but have ecological importance	Chapter 9, Page 108
3	Biomacromolecules	Types of Biomacromolecules	Proteins	High molecular weight compounds	Chapter 9, Page 109

			Nucleic acids	High molecular weight compounds	Chapter 9, Page 109
			Polysaccharides	High molecular weight compounds	Chapter 9, Page 109
			Lipids	High molecular weight compounds	Chapter 9, Page 109
		Structure and Function	Heteropolymers	Structural roles, catalytic functions	Chapter 9, Page 110
			Structural roles	Examples: collagen in connective tissue	Chapter 9, Page 110
			Catalytic functions	Examples: enzymes like trypsin	Chapter 9, Page 110
4	Proteins	Types of Proteins	Collagen	Provides structural support	Chapter 9, Page 110
			Insulin	Regulates blood sugar levels	Chapter 9, Page 110
			Trypsin	Digestive enzyme	Chapter 9, Page 110
			Antibodies	Protects against pathogens	Chapter 9, Page 110
			Receptors	Involved in signal transduction	Chapter 9, Page 110
		Structure of Proteins	Primary structure	Sequence of amino acids	Chapter 9, Page 112
			Secondary structure	Alpha-helix, beta-sheet	Chapter 9, Page 112
			Tertiary structure	Three-dimensional structure	Chapter 9, Page 112
			Quaternary structure	Association of multiple polypeptide chains	Chapter 9, Page 112

5	Polysaccharides	Types of Polysaccharides	Cellulose	Structural component in plant cell walls	Chapter 9, Page 111
			Starch	Energy storage in plants	Chapter 9, Page 111
			Glycogen	Energy storage in animals	Chapter 9, Page 111
		Function	Energy storage	Starch in plants, glycogen in animals	Chapter 9, Page 111
			Structural components	Cellulose in plant cell walls	Chapter 9, Page 111
6	Nucleic Acids	Types of Nucleic Acids	DNA	Double-stranded, carries genetic information	Chapter 9, Page 112
			RNA	Single-stranded, involved in protein synthesis	Chapter 9, Page 112
		Structure of Nucleic Acids	Nucleotide structure	Composed of a sugar, phosphate group, and nitrogenous base	Chapter 9, Page 112
			Sugar-phosphate backbone	Provides structural framework for nucleic acids	Chapter 9, Page 112
			DNA structure	Contains deoxyribose sugar, double helix	Chapter 9, Page 112
			RNA structure	Contains ribose sugar, single-stranded	Chapter 9, Page 112
7	Enzymes	Nature and Function	Proteinaceous	Made of proteins, highly specific	Chapter 9, Page 113
			Catalytic power	Increase reaction rates, lower activation energy	Chapter 9, Page 113
		Factors Affecting Enzyme Activity	Temperature	Enzymes have optimal temperature	Chapter 9, Page 114

			pH	Enzymes have optimal pH	Chapter 9, Page 114
			Substrate concentration	Affects the rate of enzyme activity	Chapter 9, Page 114
			Inhibitors	Chemicals that reduce enzyme activity	Chapter 9, Page 114
		Classification of Enzymes	Oxidoreductases	Catalyze oxidation-reduction reactions	Chapter 9, Page 115
			Transferases	Transfer functional groups between molecules	Chapter 9, Page 115
			Hydrolases	Catalyze hydrolysis reactions	Chapter 9, Page 115
			Lyases	Catalyze the breaking of bonds by means other than hydrolysis and oxidation	Chapter 9, Page 115
			Isomerases	Catalyze isomerization changes within a single molecule	Chapter 9, Page 115
			Ligases	Join two molecules together	Chapter 9, Page 115
		Co-factors	Prosthetic groups	Tightly bound to enzymes, necessary for enzyme activity	Chapter 9, Page 116
			Co-enzymes	Loosely bound to enzymes, often vitamins	Chapter 9, Page 116
			Metal ions	Act as enzyme activators, examples: Mg^{2+}, Zn^{2+}	Chapter 9, Page 116

Chapter 10: Cell Cycle and Cell Division

Sl	Topic	Subtopics	Concepts/Subconcepts	Details/Examples	References
1	Cell Cycle	Phases of Cell Cycle	Interphase	The phase between two successive M phases	Chapter 10, Page 121
			M Phase	Mitosis phase, actual cell division	Chapter 10, Page 121
2	Interphase	G1 Phase	Interval between mitosis and initiation of DNA replication	Cell is metabolically active and grows continuously	Chapter 10, Page 121
		S Phase	DNA synthesis or replication occurs	Amount of DNA per cell doubles	Chapter 10, Page 121
		G2 Phase	Proteins are synthesized, and cell growth continues	Prepares for mitosis	Chapter 10, Page 121
3	M Phase	Stages of Mitosis	Prophase	Chromosomal material condenses, centrosomes move to opposite poles	Chapter 10, Page 122
			Metaphase	Chromosomes align at the equatorial plate	Chapter 10, Page 123
			Anaphase	Centromeres split, chromatids move to opposite poles	Chapter 10, Page 124
			Telophase	Chromosomes decondense, nuclear envelope reappears	Chapter 10, Page 124
		Cytokinesis	Division of cytoplasm	In animal cells, achieved by the formation of a furrow in the plasma membrane	Chapter 10, Page 125

4	Significance of Mitosis	Importance	Growth of multicellular organisms	Mitosis results in the production of diploid daughter cells	Chapter 10, Page 125
			Cell repair	Replacement of damaged or dead cells	Chapter 10, Page 125
5	Meiosis	Key Features	Reduction division	Chromosome number is reduced by half during meiosis	Chapter 10, Page 126
			Two sequential cycles of division	Meiosis I and Meiosis II	Chapter 10, Page 126
			Formation of four haploid cells	Result of meiosis II	Chapter 10, Page 126
6	Stages of Meiosis	Meiosis I	Prophase I	Chromosomes condense, homologous chromosomes pair	Chapter 10, Page 127
			Metaphase I	Bivalent chromosomes align at the equatorial plate	Chapter 10, Page 127
			Anaphase I	Homologous chromosomes separate	Chapter 10, Page 127
			Telophase I	Nuclear membrane reappears, cytokinesis follows	Chapter 10, Page 127
		Meiosis II	Prophase II	Chromosomes condense again, nuclear membrane disappears	Chapter 10, Page 127
			Metaphase II	Chromosomes align at the equator	Chapter 10, Page 128

			Anaphase II	Sister chromatids separate	Chapter 10, Page 128
			Telophase II	Formation of four haploid daughter cells	Chapter 10, Page 128
7	Significance of Meiosis	Importance	Maintenance of chromosome number	Ensures consistent chromosome number across generations	Chapter 10, Page 128
			Genetic variability	Increases genetic variation through recombination	Chapter 10, Page 128