CollegeBoard

Name of textbook: *Principles of Life* **Edition:** 1st edition
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Big Idea 1: The process of evolution drives the diversity and unity of life.

Essential knowledge	Chapters/sections	Illustrative examples covered
1.a.1 Natural selection is a major mechanism of evolution	1.4, 15.1-7, 43.4	• Graphical analysis of allele frequencies in a population • Application of Hardy-Weinberg Equation
1.a.2 Natural selection acts on phenotypic variations in populations	15.1-7, 22 opening and Q&A, 44.3	• DDT resistance in insects • Artificial selection • Loss of genetic diversity within a crop species • Overuse of antibiotics
1.a.3: Evolutionary change is also driven by random processes	15.2, 15.5	*No illustrative examples listed in Curriculum Framework.*
1.a.4 Biological evolution is supported by scientific evidence from many disciplines, including mathematics.	15.1, 15.3, 16.1-4, 18.1-3	• Graphical analyses of allele frequencies in a population • Analysis of sequence data sets • Analysis of phylogenetic trees • Construction of phylogenetic trees based on sequence data
1.b.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	1.1, 16.1-4, 19.1, 38.2	• Cytoskeleton (a network of structural proteins that facilitate cell movement, morphological integrity, organelle transport) • Membrane-bound organelles (mitochondria and/or chloroplasts) • Linear chromosomes • Endomembrane systems, including the nuclear envelope
1.b.2 Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.	1.1, 16.1-16.4, 19.1, 20.2, 21.1, 22.3, 23.1, 23.6, 42.4	• Number of heart chambers in animals • Absence of legs in some sea mammals
1.c.1 Speciation and extinction have occurred throughout the Earth's history.	17.1-4, 18.1-3, 43.5, 44.2,45.6	• Five major extinctions • Human impact on ecosystems and species extinction rates
1.c.2 Speciation may occur when two populations become reproductively isolated from	17.2, 17.3, 42.4	*No illustrative examples listed in Curriculum Framework.*

each other.		
1.c.3 Populations of organisms continue to evolve.	15.1-7; 17.4, 44.3	• Chemical resistance • Emergent diseases • Observed directional phenotypic change in a population • A eukaryotic example that describes evolution of a structure or process
1.d.1 There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.	1.1, 2 Opening and Q&A, 6.1	*No illustrative examples listed in Curriculum Framework.*
1.d.2 Scientific evidence from many different disciplines supports models of the origin of life.	1.1, 2 Opening and Q&A, 3.3, 4 Q&A, 6.1	*No illustrative examples listed in Curriculum Framework.*

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Essential knowledge	Chapters/sections	Illustrative examples covered
2.a.1 All living systems require constant input of free energy.	2.6, 6.1, 6.2, 6.3, 6.4, 6.5, 39.1, 43.3, 45.3	• Krebs cycle • Glycolysis • Calvin cycle • Fermentation • Seasonal reproduction in animals and plants • Ectothermy • Endothermy • Seasonal reproduction • Life history strategy • Change in primary production affects higher trophic levels • Change in each trophic level affects higher trophic levels
2.a.2 Organisms capture and store free energy for use in biological processes.	6.1, 6.2, 6.3, 39.1, 45.3, 46.2	• NADP in photosynthesis • Oxygen in cellular respiration
2.a.3 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	2.2, 25.1, 29.4, 37.2. 38.5, 39.1, 39.3, 43.3, 46.2, 46.3	• Cohesion, adhesion, high specific heat, universal solvent • Root hairs • Cells of villi • Cells of alveoli • Microvilli

2.b.1 Cell membranes are selectively permeable due to their structure.	5.1, 34.2, 40.3, 40.5	*No illustrative examples listed in Curriculum Framework.*
2.b.2 Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	5.2, 5.3, 5.4, 29.1	• Glucose transport • Na^+/K^+ transport
2.b.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	4.3	• Endoplasmic reticulum • Mitochondria • Chloroplasts • Golgi • Nuclear envelope
2.c.1 Organisms use negative feedback mechanisms to maintain their internal environments and respond to external environmental changes.	7.2, 11.1, 11.2, 28.3, 29.2, 30.3, 32.4, 27.4, 38.6, 39.4	• Operons in gene regulation • Plants and water limitations • Cell cycle checkpoints • Temperature regulation in animals • Plant responses to water limitation • Lactation in mammals • Onset of labor • Ripening of fruit • Diabetes mellitus • Dehydration in response to decreased ADH • Blood clotting
2.c.2 Organisms respond to changes in their external environments.	27.2, 29.3, 35.1-4, 41.4, 42.3	• Photoperiodism in plants • Behavioral thermoregulation • Hibernation and migration in animals • Circadian rhythms • Shivering and sweating in humans
2.d.1 All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy	29.1, 29.3, 37.2, 42.1, 42.2, 43.1-6, 44.1-4, 45.1-6	• Cell density • Biofilms • Temperature • Water availability • Symbiosis • Predator-prey relationships • Water and nutrient availability • Availability of nesting sites • Food chains and food webs • Species diversity
2.d.2 Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.	29.4, 37.2, 38.2, 39.2, 40.2	• Gas exchange in aquatic and terrestrial plants • Digestive mechanisms in animals • Respiratory systems of aquatic and terrestrial animals • Nitrogeneous waste production in animals • Excretory systems in animals

		• Circulatory systems in animals • Thermoregulation in animals (countercurrent)
2.d.3 Biological systems are affected by disruptions to their dynamic homeostasis.	28.3, 31.1, 31.2, 31.3, 31.4, 31.5, 33,105, 38.1-6, 39.1-4, 43.4, 44.4, 45.5	• Plant responses to toxins, water stress and salinity • Immune response • Human impact • Invasive species • Fires • Water limitation • Salination • Dehydration • Physiological responses to toxic substances
2.d.4 Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.	28.1, 31.1, 31.2, 31.3, 31.5	• Plant defenses against pathogens • Animal nonspecific defenses and specific defenses • Mammalian cellular and humoral immunity, antibodies
2.e.1 Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.	14.1-14.3, 26.1	• Morphogenesis of fingers and toes • *C. elegans* development\ • Flower development
2.e.2 Timing and coordination of physiological events are regulated by multiple mechanisms.	26.2, 27.2, 30.4, 32.4, 34.5, 38.3, 41.3	• Circadian rhythms • Seasonal responses • Release and reaction to pheromones
2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.	41.4	• Quorum sensing in bacteria • Fruiting body formation in fungi

Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

Essential knowledge	Chapters/sections	Illustrative examples covered
3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	3.1, 3.2, 3.3, 3.4, 9.1, 9.2, 9.3, 10.1, 10.2, 10.3, 10.4, 10.5, 13.1, 13.2, 13.3, 13.4	• Poly A tail • GTP cap • Excision of introns • Enzymes • Transport by proteins • Synthesis • Degradation • GM foods • Transgenic animals • Cloned animals • Pharmaceuticals • Electrophoresis • Plasmid-based transformation • Polymerase chain reaction
3.A.2 In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis, or meiosis plus fertilization.	7.1, 7.2, 7.3, 7.4, 32.1, 32.2, 32.3	• Mitosis-promoting factor • Cancer and cell cycle control
3.A.3 The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	8.1, 8.2, 8.3, 12.4, 41.2	• Down syndrome • X-linked color blindness • Sickle cell anemia • Civic issues
3.A.4 The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	8.3, 9.3, 30.4	• Sex-linked genes • The Y chromosome carries few genes • In mammals and flies, females are XX and males are XY
3.B.1 Gene regulation results in differential gene expression, leading to cell specialization.	11.1, 11.2, 11.3, 11.4	• Promoter • Terminator • Enhancers
3.B.2 A variety of intercellular and intracellular signal transmissions mediate gene expression.	5.5, 14.3, 26.1, 26.2, 26.3, 30.4, 33.3	• Morphogens stimulate development • Cytokines regulate gene expression • HOX genes and development • Ethylene and fruit ripening • Seed germination and gibberellin

3.C.1 Changes in genotype can result in changes in phenotype.	7.4, 9.3	• Antibiotic resistance mutations • Sickle cell disorder and heterozygote advantage
3.C.2 Biological systems have multiple processes that increase genetic variation.	7.4, 8.4, 9.2	*No illustrative examples listed in Curriculum Framework.*
3.C.3 Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts.	8.4, 9.1, 12.3	• Transposons
3.D.1 Cell communication processes share common features that reflect a shared evolutionary history.	5.5, 5.6, 9.2	• Epinephrine stimulation of glycogen breakdown • DNA repair mechanisms
3.D.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.	4.5, 14.3, 28.1, 30.1, 31.4, 31.5, 34.3, 41.4	• Immune cells interact • Plasmodesmata between plant cells • Plant immune response • Morphogens and embryonic development • Neurotransmitters • Insulin • Quorum sensing in bacteria • Thyroid hormone • Testosterone • Estrogen
3.D.3. Signal transduction pathways link signal reception with cellular response.	5.5, 5.6	• G-protein linked receptors • Ligand gated ion channels • Receptor tyrosine kinases Second messengers
3.D.4. Changes in signal transduction pathways can alter cellular response.	5.6, 30, 32.1-2	• Diabetes • Effects of neurotoxins • Drugs
3.E.1. Individuals can act on information and communicate it to others.	28.2, 30.2, 41.1-4, 41.6	• Fight or flight response • Predator warnings • Colony behavior • Herbivory responses • Coloration • Parent-offspring interactions • Territorial marking • Plant-plant interactions in herbivory • Courtship and mating behaviors • Bee dances • Bird songs

3.E.2. Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.	34.1-4, 35.1-4, 36.1-3	• Acetylcholine • Epinephrine • Dopamine • Serotonin • GABA • Hearing • Muscle movement • Abstract thought • Neurohormone production • Forebrain, midbrain and hindbrain • Right and left cerebral hemispheres

Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Essential knowledge	Chapters/sections	Illustrative examples covered
4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	3.1, 3.2, 3.3, 3.4, 9.1	*No illustrative examples listed in Curriculum Framework.*
4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	4.3, 4.4, 6.2, 6.5	*No illustrative examples listed in Curriculum Framework.*
4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	14.2, 14.3, 33.1	*No illustrative examples listed in Curriculum Framework.*
4.A.4: Organisms exhibit complex properties due to interactions between their constituent parts.	24.1-3, 36.1, 36.3, 39.3	• Plant vascular and leaf • Root, stem and leaf • Kidney and bladder • Respiratory and circulatory • Nervous and muscular • Stomach and small intestines
4.A.5: Communities are composed of populations of organisms that interact in complex ways.	43.1-4, 44.1-4, 45.1-6	• Predator-prey relationship • Symbiotic relationship • Graphical representation of field data

		• Introduction of species • Global climate change models
4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	43.2, 45.3, 46.2	*No illustrative examples listed in Curriculum Framework.*
4.B.1: Interactions between molecules affect their structure and function.	3.3, 3.4	*No illustrative examples listed in Curriculum Framework.*
4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	29.1, 34.4, 36.2, 37.2, 39.4, 42.1	• Exchange of gases • Circulation of fluids • Digestion of food • Excretion of wastes • Bacterial community in the rumen • Bacterial community in the gut
4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	43.1, 43.4, 43.5, 44.1-4, 45.1-6	• Loss of keystone species
4.B.4: Distribution of local and global ecosystems changes over time.	42.1-45, 45.2, 46.5	• Continental drift • Impacts of human land use • Effects of introduced species • Volcanic eruption Impacts of climate change
4.C.1: Variation in molecular units provides cells with a wider range of functions.	5.1, 6.5, 31.4	• Phospholipids in membranes • MHC proteins • Chlorophylls • Molecular diversity in antibodies
4.C.2: Environmental factors influence the expression of the genotype in an organism.	8.2, 11.2, 39.1	• Height and weight in humans • Effect if adding lactose to a Lac^+ bacterial culture • Darker fur in cooler regions of the body
4.C.3: The level of variation in a population affects population dynamics.	15.2-4, 28.1, 28.3	• Wheat rust
4.C.4: The diversity of species within an ecosystem may influence the stability of the ecosystem.	42.5, 45.4, 46.5	*No illustrative examples listed in Curriculum Framework.*

Sections of your text book that do not have to be covered in an AP Biology course:

Sections not covered will depend on examples that are used by the teacher.