**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.

<table>
<thead>
<tr>
<th>Essential knowledge</th>
<th>Chapters/sections</th>
<th>Illustrative examples covered</th>
</tr>
</thead>
</table>
| 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.

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<thead>
<tr>
<th>Essential knowledge</th>
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</table>
| 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

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<tr>
<th>2.b.1 Cell membranes are selectively permeable due to their structure.</th>
<th>5.1, 34.2, 40.3, 40.5</th>
<th>No illustrative examples listed in Curriculum Framework.</th>
</tr>
</thead>
</table>
| 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  
● Nitrogenous waste production in animals  
● Excretory systems in animals |
| 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.

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<th>Essential knowledge</th>
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| 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.

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<tbody>
<tr>
<td>4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.</td>
<td>3.1, 3.2, 3.3, 3.4, 9.1</td>
<td>No illustrative examples listed in Curriculum Framework.</td>
</tr>
<tr>
<td>4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.</td>
<td>4.3, 4.4, 6.2, 6.5</td>
<td>No illustrative examples listed in Curriculum Framework.</td>
</tr>
</tbody>
</table>
| 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 |

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

**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.