Biology: Unity and Diversity of Life
13th Edition

	Essential Knowledge covered	Required content for the AP Course	Illustrative examples covered in this textbook - teach at least one	Content not required for the AP Course
1. Invitation to Biology				
1.1 The Secret of Life on Earth				p.3 & 19, The diversity of Foja Mountain cloud forest
1.2 Life Is More than the Sum of its Parts	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p. 4-5		
	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p. 4-5		
1.3 How Living Things are Alike	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p. 6-7		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p. 7		
1.4 How Living Things Differ				p.8-9, Overview of Earth's biodiverstiy
1.5 Organizing Information About Species				p.10-11, Taxonomy

1.6 Science of Nature				p.12-13, Scientific method and investigative processes
1.7 Examples of Experiments in Biology				p.14-15, Potato chip experiment and butterfly experiment
1.8 Analyzing Experimental Results				p.16-17, Interpretation of data and potential problems
1.9 The Nature of Science				p.18, Development of scientific theories
2.0 Life's Chemical Basis				
2.1 Mercury Rising				p.23 & 33, Bioaccumulation of mercury
2.2 Start with Atoms				p.24-25, Atomic structure; isotopes
2.3 Why Electrons Matter				p.26-27, Electrons shells, orbitals and valence.
2.4 Chemical Bonds: From Atoms to Molecules				p.28-29, Types of chemical bonds; polarity

2.5 Hydrogen Bonds and Water	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.30-31, Hydrogen bonds and the properties of water	p.30, Cohesion and adhesion of water; p.30-31, Temperature stabilizing effect; p.31, Universal solvent	
2.6 Acids and Bases				p.32
3.0 Molecules of Life				
3.1 Fear of Frying				p.37 & 49, *trans* fats
3.2 Organic Molecules				p.38-39, Carbon; Molecular modeling
3.3 Molecules of Life -- From Structure to Function				p.40-41, Functional groups; Hydrolysis and condesation reactions; Monomers and polymers
3.4 Carbohydrates	Essential Knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	p. 42-43		
3.5 Greasy, Oily -- Must be Lipids	Essential Knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	p. 44-45		

3.6 Proteins -- Diversity in Structure and Function	Essential Knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	p.46-47		
3.7 Why is Protein Structure So Important	Essential Knowledge 4.B.1: Interactions between molecules affect their structure and function.	p.48		
3.8 Nucleic Acids	Essential Knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	p.49		
4.0 Cell Structure and Function				
4.1 Food for Thought				p.53 & 73, Harmful strains of *E. coli*
4.2 Cell Structure	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.54-55		
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.54-55		

	Essential Knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	p.54-55		
4.3 How do We See Cells?				p.56-57, Microscope technologies
4.4 Introducing "Prokaryotes"	Essential Knowledge 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	p.58-59	p.59, Biofilms	
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.58-59		
	Essential Knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	p.58-59		
4.5 Introducing Eukaryotic Cells	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.60-61	p.60, Membrane-bound organelles	

	Essential Knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.	p.60-61		
	Essential Knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	p.60-61		
	Essential Knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	p.60-61	p.61, Endoplasmic reticulum, mitochondria, chloroplasts, Golgi	
4.6 Nuclear Envelope	Essential Knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	p.62-63	p.62-63, Nuclear envelope	
4.7 Endomembrane System	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.64-65	p.64-65, Endomembrane system	
	Essential Knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	p.64-65		

	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.64-65		
4.8 Lysosome Malfunction				p.68, Tay-Sachs disease (*focus here is one the lysosome*)
4.9 Other Organelles	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.66-67		
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.66-67		
	Essential Knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	p.66-67		
4.10 The Dynamic Cytoskeleton	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.68-69	p.68-69, Cytoskeleton (a network of structural proteins that facilitate cell movement, morphological integrity and organelle transport).	

	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.68-69		
4.11 Cell Surface Specializations	Essential Knowledge 3.D.2: Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.	p.70-71	p.71, Plasmodesmata between plant cells allow material to be transported from cell to cell	
4.12 The Nature of Life				p.72, Biological characteristics of life
5 Ground Rules for Metabolism				
5.1 A Toast to Alcohol Dehydrogenase				p.77 & 96-97, Alcoholism
5.2 Energy in the World of Life	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.78-79		
	Essential Knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	p.78-79		
5.3 Energy in the Molecules of Life	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.80-81		

5.4 How Enzymes Work	Essential Knowledge 4.B.1: Interactions between molecules affect their structure and function.	p.82-83		
5.5 Metabolism -- Organized, Enzyme-Mediated Reactions	Essential Knowledge 4.B.1: Interactions between molecules affect their structure and function.	p.84-85		
5.6 Cofactors in Metabolic Pathways	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.86-87		
	Essential Knowledge 4.B.1: Interactions between molecules affect their structure and function.	p.86-87	p.86, Heme catalyzes reactions	
5.7 A Closer Look at Membranes	Essential Knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.	p.88-89		
	Essential Knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	p.88-89	p.88, Glucose transporter	
	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.88-89		

	Essential Knowledge 3.D.1: Cell communication processes share common features that reflect a shared evolutionary history.	p.88-89		
	Essential Knowledge 3.D.3: Signal transduction pathways link signal reception with cellular response.	p.88-89		
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.88-89		
	Essential Knowledge 4.B.1: Interactions between molecules affect their structure and function.	p.88-89		
	Essential Knowledge 4.C.1: Variation in molecular units provides cells with a wider range of functions.	p.88-89	p.88, Different types of phospholipids in cell membranes; MHC proteins	
5.8 Diffusion and Membranes	Essential Knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.	p.90-91		

	Essential Knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	p.90-91		
	Essential Knowledge 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.	p.90-91	p.91, Plant responses to water limitations (plasmolysis)	
	Essential Knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	p.90-91		
5.9 Membrane Transport Mechanisms	Essential Knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.	p.92-93		
	Essential Knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	p.92-93	p.92, Transport of glucose; p.93, Calcium pump & Na/K pump	
	Essential Knowledge 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.	p.92-93		

	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.92-93		
	Essential Knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	p.92-93		
5.10 Membrane Trafficking	Essential Knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	p.94-95		
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.94-95		
	Essential Knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	p.94-95		
6 Where it All Starts -- Photosynthesis				
6.1 Biofuels				p.101 & 112, Biofeuls and early Earth atmosphere

6.2 Sunlight as an Energy Source	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.102-103		
	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.102-103		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.102-103	p.102, Chlorophylls	
	Essential Knowledge 4.C.1: Variation in molecular units provides cells with a wider range of functions.	p.102-103		
6.3 Exploring the Rainbow	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.104		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.104		
6.4 An Overview of Photosynthesis	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.105	p.105, $NADP^+$ in photosynthesis	

	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.105		
6.5 Light-Dependent Reactions	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.106-107		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.106-107		
6.6 Energy Flow in Photosynthesis	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.108		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.108		
6.7 Light-Independent Reactions	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.109		

	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.109	p.109, Calvin cycle	
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.109		
6.8 Adaptations: Different Carbon-Fixing Pathways	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.110-111		
7 How Cells Release Chemical Energy				
7.1 Mighty Mitochondria	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.117 & p.129		
7.2 Overview of Carbohydrate Breakdown Pathways	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.118-119	p.119, Glycolysis, Krebs cycle	
	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.118-119		

	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.118-119	p.118, Oxygen in cellular respiration	
	Essential Knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	p.118-119		
7.3 Glycolysis -- Glucose Breakdown Starts	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.120-121		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.120-121		
7.4 Second Stage of Aerobic Respiration	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.122-123		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.122-123		

7.5 Aerobic Respiration's Big Energy Payoff	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.124-125		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.124-125		
7.6 Fermentation	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.126-127	p.126, Fermentation	
	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.126-127		
	Essential Knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	p.126-127		
7.7 Alternative Energy Sources in Food				p.128, Biochemical processing of other macromolecules
8 DNA Structure and Function				

8.1 A Hero Dog's Golden Clones	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.133 & 145	p.133, Cloned animals	
8.2 Eukaryotic Chromosomes	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.134-135	p.134, Linear chromosomes	
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.134-135		
	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.134-135	p.135, In mammals and flies, females are XX and males are XY; The Y chromosome is very small and carries few genes	
8.3 The Discovery of DNA's Function	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.136-137	p.136-137, The Griffith and Hershey-Chase experiments	
8.4 The Discovery of DNA's Structure	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.138-139		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.138-139	p.138-139, Watson & Crick, Rosalind Franklin	

	Essential Knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.	p.138-139		
8.5 DNA Replication	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.140-141		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.140-141		
	Essential Knowledge 3.C.1: Changes in genotype can result in changes in phenotype.	p.140-141		
8.6 Mutations -- Cause and Effect	Essential Knowledge 3.C.1: Changes in genotype can result in changes in phenotype.	p.142-143		
	Essential Knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.	p.142-143		
	Essential Knowledge 3.D.1: Cell communication processes share common features that reflect a shared evolutionary history.	p.142-143	p.142, DNA repair mechanisms	

8.7 Animal Cloning	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.144	p.144, Animal cloning	
9 From DNA to Protein				
9.1 The Aptly Acronymed RIPs				p.149 & 160, Ribosome-inactivating proteins
9.2 DNA, RNA and Gene Expression	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.150-151		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.150-151	p.150, Protein synthesis	
9.3 Transcription: DNA to RNA	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.152-153		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.152-153	p.153, Addition of poly-A tail and GTP cap; Excision of introns	

	Essential Knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.	p.152-153	p.152, DNA promoter	
	Essential Knowledge 3.C.1: Changes in genotype can result in changes in phenotype.	p.152-153		
9.4 RNA and the Genetic Code	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.154-155		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.154-155		
9.5 Translation: RNA to Protein	Essential Knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	p.156-157		
	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.156-157		
9.6 Mutated Genes and Their Protein Products	Essential Knowledge 1.A.2: Natural selection acts on phenotypic variations in populations.	p.158-159	p.159, Sickle cell disease	

	Essential Knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.	p.158-159		
	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.158-159	p.159, Sickle cell disease	
	Essential Knowledge 3.C.1: Changes in genotype can result in changes in phenotype.	p.158-159	p.159, Sickle cell disease and heterozygote advantage	
10 Gene Control				
10.1 Between You and Eternity	Essential Knowledge 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.	p.163 & 173	p.163, Cancer results from disruptions in cell-cycle control	
	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.163 & 173	p.173, Changes to tumor suppressor genes can result in cancer	

10.2 Switching Genes On and Off	Essential Knowledge 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.	p.164-165		
	Essential Knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.	p.164-165	p.164, Enhancers, promoters, and repressors	
	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.164-165		
	Essential Knowledge 4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	p.164-165	p.164, Cell differentiation	
10.3 Master Genes	Essential Knowledge 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.	p.166-167		

	Essential Knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.	p.166-167		
	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.166-167	p.166, HOX (homeotic) genes and their role in development	
10.4 Examples of Gene Control in Eukaryotes	Essential Knowledge 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.	p.168-169	p.169, Flower development	
	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.168-169	p.168, Some traits are sex limited and expression depends on the sex of the individual.	
	Essential Knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.	p.168-169		
	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.168-169	p.168, Expression of the SRY gene triggers the male sexual development pathway in animals	

	Essential Knowledge 4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	p.168-169		
10.5 Examples of Gene Control in Prokaryotes	Essential Knowledge 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.	p.170-171	p.170, Operons in gene regulation	
	Essential Knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.	p.170-171		
	Essential Knowledge 4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	p.170-171		
	Essential Knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.	p.170-171	p.170-171, Effect of adding lactose to a Lac + bacterial culture	
10.6 Epigenetics	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.172		

11 How Cells Reproduce				
11.1 Henrietta's Immortal Cells				p.177 & 186, HeLA cell line
11.2 Multiplication by Division	Essential Knowledge 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.	p.178-179		
11.3 A Closer Look at Mitosis	Essential Knowledge 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.	p.180-181		
11.4 Cytokinesis: Division of Cytoplasm	Essential Knowledge 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.	p.182		
11.5 Marking Time with Telomeres				p.183, telomeres
11.6 When Mitosis Becomes Pathological	Essential Knowledge 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	p.184-185	p.185, Cell density	

	Essential Knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	p.184-185	p.184, Mutations to oncogenes or proto-oncogenes can result in cancer	
	Essential Knowledge 3.D.4: Changes in signal transduction pathways can alter cellular response.	p.184-185	p.184-185, Changes in signal transduction pathways is seen with altered tumor cells in cancer	
12 Meiosis and Sexual Reproduction				
12.1 Why Sex?				p.189 & 200, Evolution of sexual reproduction
12.2 Meiosis Halves the Chromosome Number	Essential Knowledge 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.	p.190-191		
12.3 Tour of Meiosis	Essential Knowledge 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.	p.192-193		

12.4 How Meiosis Introduces Variation in Traits	Essential Knowledge 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.	p.194-195		
	Essential Knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.	p.194-195		
12.5 From Gametes to Offspring	Essential Knowledge 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.	p.196-197		
12.6 Mitosis and Meiosis -- An Ancestral Connection?				p.198-199, Evolution of cellular division
13 Observing Patterns in Inherited Traits				
13.1 Menacing Mucus	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.203 & 215	p.203 & 215, Cystic fibrosis	

13.2 Mendel, Pea Plants, and Inheritance Patterns	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.204-205		
13.3 Mendel's Law of Segregation	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.206-207		
13.4 Mendel's Law of Independent Assortment	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.208-209		
	Essential Knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.	p.208-209		
13.5 Beyond Simple Dominance	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.210-211		

	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.210-211	p.210-211, Incomplete dominance, codominance, multiple allelic genes, epistasis, pleiotropy	
13.6 Nature and Nurture	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.212-213		
	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.212-213		
	Essential Knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.	p.212-213	p.213, Alternate phenotypes in water fleas; flower color based on soil pH	
13.7 Complex Variation in Traits	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.214-215		
	Essential Knowledge 4.C.3: The level of variation in a population affects population dynamics.	p.214-215		

14 Chromosomes and Human Inheritance				
14.1 Shades of Skin	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.219 & 232		
	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.219 & 232		
14.2 Human Chromosomes	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.220-221		
	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.220-221		
14.3 Examples of Autsomal Inheritance Patterns	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.222-223	p.222, Achrondoplasia, Huntington's disease; p.223, Progeria, albinism, Tay-Sachs	

	Essential Knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	p.222-223		
14.4 Examples of X-linked Inheritance Patterns	Essential Knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring	p.224-225	p.224, X-linked color blindness; p.225, DMD, hemophilia	
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43.7 Mates, Offspring, and Reproductive Success	Essential Knowledge 2.E.2: Timing and coordination of physiological events are regulated by multiple mechanisms.	p.782-783	p.782-783, Visual displays in the reproductive cycle	
	Essential knowledge 3.E.1: Individuals can act on information and communicate it to others	p.782-783	p.782-783, Territorial behavior, parental care, and courtship and mating behaviors	
43.8 Living in Groups	Essential knowledge 3.E.1: Individuals can act on information and communicate it to others	p.784-785	p.784-785, Pack and herd behavior; Protection of young	
43.9 Why Sacrifice Yourself?	Essential Knowledge 3.D.1: Cell communication processes share common features that reflect a shared evolutionary history.	p.786	p.786, Use of pheromones to trigger reproduction pathways	
44 Population Ecology				
44.1 A Honking Mess				p.791 & 806, Nuisance geese

44.2 Population Demographics	Essential Knowledge 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	p.792-793	p.792, Population density	
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.792-793		
44.3 Population Size and Exponential Growth	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.794-795		
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.794-795		
44.4 Limits on Population Growth	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.796-797		

	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.796-797		
44.5 Life History Patterns	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.798-799	p.799, Life history patterns	
44.6 Evidence of Evolving Life History Patterns	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.800-801	p.800-801, Graphical representation of field data	
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.800-801		
44.7 Human Population Growth	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.802-803		
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.802-803		

44.8 Anticipated Growth and Consumption				p.804-805, Human fertility rates, population pyramids and ecological footprint
45 Community Ecology				
45.1 Fighting Foreign Fire Ants	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.809 & 825	p.809 & 825, Introduction of species	
	Essential Knowledge 4.B.4: Distribution of local and global ecosystems changes over time.	p.809 & 825	p.809 & 825, An introduced species can exploit a new niche free of predators and competition	
	Essential Knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	p.809 & 825	p.809 & 825, Invasive and exotic species	
45.2 Which Factors Shape Community Structure?	Essential Knowledge 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	p.810	p.810, Symbiotis (mutualism, competition, parasitism)	

	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.810	p.810, Symbiotic relationship	
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.810		
45.3 Mutualism	Essential Knowledge 2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.	p.811	p.811, Mutualistic relationships	
	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.811		
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.811		
45.4 Competitive Interactions	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.812-813		

	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.812-813		
45.5 Predator-Prey Interactions	Essential Knowledge 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	p.814-815	p.814-815, Predator-prey relationships	
	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.814-815	p.815, Predator/prey relationships spreadsheet model	
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.814-815		
45.6 An Evolutionary Arms Race	Essential Knowledge 3.E.1: Individuals can act on information and communicate it to others.	p.816-817	p.817, Plant-plant interactions due to herbivory	

	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.816-817		
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.816-817		
	Essential Knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.	p.816-817	p.817, Physical deterrents in plants due to herbivory	
45.7 Parasites and Parasitoids	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.818-819		
	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.818-819		
45.8 Ecological Succession				p.820-821, Ecological succession
45.9 Species Introduction, Loss, and Other Disturbances	Essential Knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	p.822-823	p.822-823, Invasive and exotic species	

	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.822-823	p.822-823, Introduction of species	
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45.10 Biogeographic Patterns in Community Structure				p.824, Biogeography
46 Ecosystems				
46.1 Too Much of a Good Thing	Essential Knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	p.829 & 845	p.829 & 845, Eutrophication	
46.2 Nature of Ecosystems	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.830-831		

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	Essential Knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	p.830-831		
46.3 The Nature of Food Webs	Essential Knowledge 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	p.832-833	p.832-833, Food webs	
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46.4 Energy Flow	Essential Knowledge 2.A.1: All living systems require constant input of free energy.	p.834-835		

	Essential Knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	p.834-835		
46.5 Biogeochemical Cycles	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.836		
46.6 The Water Cycle	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.836-837		
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46.7 Carbon Cycle	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.838-839		
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46.8 Greenhouse Gases and Climate Change	Essential Knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	p.840-841	p.841, Global climate change models	
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46.9 Nitrogen Cycle	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.842		
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46.10 Disruption of the Nitrogen Cycle				p.843, Nitrogen pollution
46.11 The Phosphorus Cycle	Essential Knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	p.844		
	Essential Knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	p.844		
47 The Biosphere				
47.1 Warming Water and Wild Weather	Essential Knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	p.849 & 873	p.849 & 873, Wild weather	

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47.2 Global Air Circulation Patterns	Essential Knowledge 4.B.4: Distribution of local and global ecosystems changes over time.	p.850-851		
47.3 The Ocean, Landforms, and Climates	Essential Knowledge 4.B.4: Distribution of local and global ecosystems changes over time.	p.852-853	p.852-853, Rain shadow effect	
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47.9 Coniferous Forests				p.862, Coniferous forest biome
47.10 Tundra				p.863, Tundra biome
47.11 Freshwater Ecosystems				p.864-865, Freshwater lakes, rivers and streams
47.12 Coastal Ecosystems				p.866-867, Coastal ecosystems
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48 Human Impacts on the Biosphere				
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48.2 The Extinction Crisis	Essential Knowledge 1.A.2: Natural selection acts on phenotypic variations in populations.	p.878-879		
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48.3 Currently Threatened Species	Essential Knowledge 1.C.1: Speciation and extinction have occurred throughout the Earth's history.	p.880-881	p.880-881, Human impact on ecosystems and species extinction rates	

48.4 Harmful Land Practices	Essential Knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	p.882-883	p.882-883, Desertification	
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48.8 Conservation Biology	Essential Knowledge 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	p.888-889	p.888, Biodiversity	
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