Instructional Units Plan
Biology

This set of plans presents the topics and selected ACT Course Standards for ACT's rigorous Biology course. The topics and standards are arranged in sixteen units by suggested instructional sequence. Unit 3 is a Model Instructional Unit developed by ACT that illustrates exemplary practice and shows how the Course Standards are best connected to classroom instruction. Teachers can use the *Guidelines for Developing an Instructional Unit* to develop additional instructional units based on the topics listed in this document.

Unit No.	Unit Topic
1	Introduction to Biology: A Look into Biology
2	Demystifying the Nature of Science
3	The Five-Second Rule: A Rule to Live by or a Myth to Bust?
4	Atomically Correct: The Chemistry of Life
5	Organic Chemistry: The Molecules of Life
6	The Organization of the Biosphere
7	Ecology: Populations, Communities, and Ecosystems
8	Cell-ebrate: The Functions of Cellular Structures
9	Cellular Respiration
10	A Study of Photosynthesis
11	Genetics and Biotechnology
12	Mendel's Peas: A Study of Mendelian Genetics
13	Beaks, Beans, and M&M's®: A Study of Natural Selection
14	Evolution of Early Earth and Speciation
15	Relationships Among Organisms
16	Animals

Unit 1
Introduction to Biology: A Look into Biology

ACT Course Standards

Unit 1 Introduction to Biology: A Look into Biology		
A.1.	Scientific Inquiry	c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.2.	Mathematics and Measurement in Science	a. Use appropriate SI units for length, mass, time, temperature, quantity, area, volume, and density, and describe the relationships among SI unit prefixes (e.g., centi-, milli-, kilo-) and how SI units are related to analogous English units
		c. Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.3.	Science in Practice	a. Describe the fundamental assumptions of science
		f. Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
A.4.	Foundations	a. Describe the biological criteria that need to be met in order for an organism to be considered alive
		d. Use mathematics to enhance the scientific inquiry process (e.g., choosing appropriate units of measurement, graphing and manipulating experimental data)
A.2.	Reading Strategies (From English 10 standards)	a. Apply strategies before, during, and after reading to increase fluency and comprehension (e.g., adjusting purpose, previewing, scanning, making predictions, comparing, inferring, summarizing, using graphic organizers) with increasingly challenging texts
A.8.	Words and Their History (From English 10 standards)	a. Apply knowledge of Greek, Latin, and Anglo-Saxon affixes, inflections, and roots to understand unfamiliar words and new subject area vocabulary in increasingly challenging texts (e.g., words in science, mathematics, and social studies)
D.2.	Application (From English 10 standards)	f. Apply analytic and active listening strategies (e.g., paraphrasing, monitoring messages for clarity, selecting and organizing essential information, noting change of pace cues) in formal and informal settings
		g. Actively participate in small-group and large-group discussions, assuming various roles
E.	Study Skills and Test Taking (From English 10 standards)	a. Apply active reading, listening, and viewing techniques by taking notes on classroom discussions, lectures, oral and/or video presentations, or assigned at-home reading, and by underlining key passages and writing comments in journals or in margins of texts, where permitted
		b. Demonstrate organizational skills such as keeping a daily calendar of assignments and activities and maintaining a notebook of class work
		c. Use appropriate essay-test-taking and timed-writing strategies that address and analyze the question (prompt)
		d. Demonstrate familiarity with test formats and test administration procedures to increase speed and accuracy

Unit 2 Summary
Demystifying the Nature of Science

Students will first complete a worksheet to assess their prior knowledge about what science is and how science is practiced. They will engage in activities that allow them to practice their observational skills, to formulate inferences and predictions based on their observations, and to revise those inferences and predictions if necessary. As they learn more about the nature of science, students will revisit their initial responses and modify them to reflect their new understanding.

The similarities and differences among the scientific and nonscientific definitions of *fact*, *law*, and *theory* will be researched and discussed. Students will compare two types of scientific inquiry—basic science and applied science—then compare both to technology. They will discuss how society places different values on the three types of research.

ACT Course Standards

Unit 2 Demystifying the Nature of Science		
A.1.	Scientific Inquiry	b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.3.	Science in Practice	d. Explain why scientific explanations must meet certain criteria (e.g., be consistent with experimental/observational evidence about nature, be open to critique and modification, be subject to peer review, use ethical reporting methods and procedures)
		f. Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
		g. Compare the goals and procedures followed in basic science with the goals and procedures of applied science and technology; discuss the important contributions of each and how citizens need to understand the ramifications of funding both endeavors
		h. Explain how the contributions of basic science drive the potential of applied science (e.g., advantages found in nature can be emulated for our own benefit/product development, such as observations of gecko feet suggesting new adhesives; understanding of basic cell biology leading to cancer treatments)
A.2.	Reading Strategies (From English 10 standards)	a. Apply strategies before, during, and after reading to increase fluency and comprehension (e.g., adjusting purpose, previewing, scanning, making predictions, comparing, inferring, summarizing, using graphic organizers) with increasingly challenging texts
		b. Use metacognitive skills (i.e., monitor, regulate, and orchestrate one's understanding) when reading increasingly challenging texts, using the most appropriate "fix-up" strategies (e.g., rereading, reading on, changing rate of reading, subvocalizing)
A.6.	Persuasive Language and Logic (From English 10 standards)	d. Distinguish between fact and opinion, basing judgments on evidence and reasoning
D.2.	Application (From English 10 standards)	g. Actively participate in small-group and large-group discussions, assuming various roles

Unit 3 Summary
The Five-Second Rule: A Rule to Live by or a Myth to Bust?

This is a two-week unit that is best started on a Wednesday. It suggests a student-centered approach to building students' understanding of the process of scientific inquiry. Through student and teacher collaboration, trial and error, and thoughtful redirection, students will conduct an investigation while actively engaged in developing a meaningful understanding of the inquiry process.

ACT Course Standards

Unit 3 The Five-Second Rule: A Rule to Live by or a Myth to Bust?		
A.1.	Scientific Inquiry	a. Identify and clarify scientific research questions and design experiments
		b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.3.	Science in Practice	a. Describe the fundamental assumptions of science
		c. Recognize and apply criteria that scientists use to evaluate the validity of scientific claims and theories
A.4.	Foundations	c. Design and conduct investigations appropriately using essential processes of scientific inquiry
E.3.	Relationships Among Organisms	e. Distinguish between and among viruses, monerans, and protists, and give examples of each
B.1.	Writing Process (From English 10 standards)	b. Analyze writing assignments in terms of purpose and audience to determine which strategies to use (e.g., writing a letter to the editor endorsing need for a dog park)
		c. Revise, refine, and proofread own and others' writing, using appropriate tools (e.g., checklists, writing conferences, student-developed and professional rubrics or models), to find strengths and weaknesses and to seek strategies for improvement
B.2.	Modes of Writing for Different Purposes and Audiences (From English 10 standards)	e. Craft first and final drafts of workplace and other real-life writing (e.g., job applications, editorials, meeting minutes) that are appropriate to the audience, provide clear and purposeful information, and use a format appropriate to the task
B.3.	Organization, Unity, and Coherence (From English 10 standards)	b. Organize writing to create a coherent whole with effective, fully developed paragraphs, similar ideas grouped together for unity, and paragraphs arranged in a logical sequence
B.5.	Conventions of Usage (From English 10 standards)	a. Correctly spell commonly misspelled/confused words
		b. Correctly choose verb forms in terms of tense, voice (i.e., active and passive), and mood for continuity
		c. Make subject and verb agree in number, even when there is some text between the subject and verb
		d. Use pronouns correctly (e.g., appropriate case, pronoun-antecedent agreement, clear pronoun reference)

Unit 4
Atomically Correct: The Chemistry of Life

ACT Course Standards

Unit 4 Atomically Correct: The Chemistry of Life		
A.1.	Scientific Inquiry	b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.3.	Science in Practice	f. Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
A.4.	Foundations	c. Design and conduct investigations appropriately using essential processes of scientific inquiry
		d. Use mathematics to enhance the scientific inquiry process (e.g., choosing appropriate units of measurement, graphing and manipulating experimental data)
A.5.	Biochemistry	a. Identify subatomic particles, and describe how they are arranged in atoms
		b. Describe the difference between ions and atoms and the importance of ions in biological processes
		c. Compare the types of bonding between atoms to form molecules
		f. Explain the fundamental principles of the pH scale and the consequences of having the different concentrations of hydrogen and hydroxide ions
		h. Describe the function of enzymes, including how enzyme-substrate specificity works, in biochemical reactions
		i. Define and explain the unique properties of water that are essential to living organisms

Unit 5
Organic Chemistry: The Molecules of Life

ACT Course Standards

Unit 5 Organic Chemistry: The Molecules of Life		
A.1.	Scientific Inquiry	a. Identify and clarify biological research questions and design experiments
		b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.5.	Biochemistry	d. Show how chemical reactions (e.g., photosynthesis, fermentation, cellular respiration) can be represented by chemical formulas
		e. Explain the difference between organic and inorganic compounds
		g. Describe the general structure and function(s), including common functional groups, of monosaccharides, disaccharides, polysaccharides, carbohydrates, fatty acids, glycerol, glycerides, lipids, amino acids, dipeptides, polypeptides, proteins, and nucleic acids
		h. Describe the function of enzymes, including how enzyme-substrate specificity works, in biochemical reactions
		i. Define and explain the unique properties of water that are essential to living organisms
		j. Explain how cells store energy temporarily as ATP

Unit 6
The Organization of the Biosphere

ACT Course Standards

Unit 6 The Organization of the Biosphere		
A.1.	Scientific Inquiry	a. Identify and clarify biological research questions and design experiments
		b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.3.	Science in Practice	f. Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
A.4.	Foundations	b. Define and provide examples of each level of organization (e.g., biosphere, biome, ecosystem, community, population, multicellular organism, organ system, organ, tissue, cell, organelle, molecule, atom, subatomic particle)
		c. Design and conduct investigations appropriately using essential processes of scientific inquiry
F.1.	Ecology	a Define and provide examples of biosphere, biome, ecosystem, community, population, species, habitat, and niche
		b. Discuss biotic and abiotic factors that affect land and aquatic biomes
		c. Discuss the role of beneficial bacteria (e.g., in the recycling of nutrients)
		d. Explain how energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers
		e. Explain how the amount of life any environment can support is limited by the available matter and energy and by the ability of ecosystems to recycle the residue of dead organic materials
		g. Diagram the flow of energy using food webs, food chains, and pyramids (e.g., pyramid of energy, pyramid of biomass, and pyramid of numbers)
		k. Explain the process of ecological succession, and describe the different communities that result
D.2.	Application (From English 10 standards)	b. Use effective delivery skills (e.g., appropriate volume, inflection, articulation, gestures, eye contact, posture, facial expression)
		c. Give impromptu and planned presentations (e.g., debates, formal meetings) that stay on topic and/or adhere to prepared notes
		g. Actively participate in small-group and large-group discussions, assuming various roles

Unit 7
Ecology: Populations, Communities, and Ecosystems

ACT Course Standards

Unit 7 Ecology: Populations, Communities, and Ecosystems			
A.1.	Scientific Inquiry	a.	Identify and clarify biological research questions and design experiments
		b.	Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c.	Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d.	Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e.	Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f.	Safely use laboratory equipment and techniques when conducting scientific investigations
A.2.	Mathematics and Measurement in Science	a.	Use appropriate SI units for length, mass, time, temperature, quantity, area, volume, and density, and describe the relationships among SI unit prefixes (e.g., centi-, milli-, kilo-) and how SI units are related to analogous English units
		c.	Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.4.	Foundations	a.	Describe the biological criteria that need to be met in order for an organism to be considered alive
		d.	Use mathematics to enhance the scientific inquiry process (e.g., choosing appropriate units of measurement, graphing and manipulating experimental data)
F.1.	Ecology	c.	Discuss the role of beneficial bacteria (e.g., in the recycling of nutrients)
		d.	Explain how energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers
		e.	Explain how the amount of life any environment can support is limited by the available matter and energy and by the ability of ecosystems to recycle the residue of dead organic materials
		f.	Explain how organisms cooperate and compete in ecosystems and how interrelationships and interdependencies of organisms may generate ecosystems that are stable for thousands of years
		g.	Diagram the flow of energy using food webs, food chains, and pyramids (e.g., pyramid of energy, pyramid of biomass, and pyramid of numbers)
		h.	Describe examples of competition, symbiosis, and predation
		i.	Explain the concept of carrying capacity
		j.	Describe the growth of populations, including exponential and logistic growth (e.g., design and conduct an experiment investigating bacterial growth using appropriate calculations)
		l.	Read and describe current journal articles relating to environmental concerns (e.g., loss of biodiversity, habitat loss, pollution)
		m.	Discuss and evaluate the significance of human interference with major ecosystems (e.g., the loss of genetic diversity in cloned crops or animals)

Unit 8
Cell-ebrate: The Functions of Cellular Structures

ACT Course Standards

Unit 8 Cell-ebrate: The Functions of Cellular Structures			
A.1.	Scientific Inquiry	a.	Identify and clarify biological research questions and design experiments
		b.	Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c.	Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d.	Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e.	Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f.	Safely use laboratory equipment and techniques when conducting scientific investigations
A.2.	Mathematics and Measurement in Science	a.	Use appropriate SI units for length, mass, time, temperature, quantity, area, volume, and density, and describe the relationships among SI unit prefixes (e.g., centi-, milli-, kilo-) and how SI units are related to analogous English units
		c.	Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.3.	Science in Practice	a.	Describe the fundamental assumptions of science
		b.	Assess how scientific and technological progress has affected other fields of study, careers, and aspects of everyday life
		f.	Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
A.4.	Foundations	c.	Design and conduct investigations appropriately using essential processes of scientific inquiry
		d.	Use mathematics to enhance the scientific inquiry process (e.g., choosing appropriate units of measurement, graphing and manipulating experimental data)
B.1.	Cells	a.	Analyze the similarities and differences among (a) plant versus animal cells and (b) eukaryotic versus prokaryotic cells
		b.	Describe the functions of all major cell organelles, including nucleus, ER, RER, Golgi apparatus, ribosome, mitochondria, microtubules, microfilaments, lysosomes, centrioles, and cell membrane
		c.	Illustrate how all cell organelles work together by describing the step-by-step process of the translation of an mRNA strand into a protein and its subsequent processing by organelles so that the protein is appropriately packaged, labeled, and eventually exported by the cell
		d.	Contrast the structure and function of subcellular components of motility (e.g., cilia, flagella, pseudopodia)
		e.	Explain how the cell membrane controls movement of substances both into and out of the cell and within the cell
		f.	Explain how the cell membrane maintains homeostasis
		g.	Describe and contrast these types of cell transport: osmosis, diffusion, facilitated diffusion, and active transport
		j.	Describe the basic process of mitosis
C.1.	Genetics	a.	Describe the basic structure and function of DNA, mRNA, tRNA, amino acids, polypeptides, and proteins (e.g., replication, transcription, and translation)

Unit 9
Cellular Respiration

ACT Course Standards

Unit 9 Cellular Respiration			
B.1.	Cells	h.	Identify the cellular sites of and follow through the major pathways of anaerobic and aerobic respiration; compare reactants and products for each process, and account for how aerobic respiration produces more ATP per monosaccharide
		i.	Explain how photosynthetic organisms use the processes of photosynthesis and respiration

Unit 10
A Study of Photosynthesis

ACT Course Standards

Unit 10 A Study of Photosynthesis			
A.1.	Scientific Inquiry	a.	Identify and clarify biological research questions and design experiments
		b.	Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c.	Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d.	Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e.	Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f.	Safely use laboratory equipment and techniques when conducting scientific investigations
A.2.	Mathematics and Measurement in Science	a.	Use appropriate SI units for length, mass, time, temperature, quantity, area, volume, and density, and describe the relationships among SI unit prefixes (e.g., centi-, milli-, kilo-) and how SI units are related to analogous English units
		c.	Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.3.	Science in Practice	a.	Describe the fundamental assumptions of science
		b.	Assess how scientific and technological progress has affected other fields of study, careers, and aspects of everyday life
		c.	Recognize and apply criteria that scientists use to evaluate the validity of scientific claims and theories
A.4.	Foundations	c.	Design and conduct investigations appropriately using essential processes of scientific inquiry
B.1.	Cells	i.	Explain how photosynthetic organisms use the processes of photosynthesis and respiration
E.2.	Plants	a.	Describe the basic mechanisms of plant processes, especially movement of materials and plant reproduction
		b.	Explain the functions of unique plant structures, including the cell wall, chloroplasts, and critical parts of the flower and the seed
		c.	Explain the interaction between pigments, absorption of light, and reflection of light
		d.	Describe the light-dependent and light-independent reactions of photosynthesis
		e.	Relate the products of the light-dependent reactions to the products of the light-independent reactions
		f.	Design and conduct an experiment (including the calculations necessary to make dilutions and prepare reagents) demonstrating effects of environmental factors on photosynthesis

Unit 11
Genetics and Biotechnology

ACT Course Standards

Unit 11 Genetics and Biotechnology			
A.1.	Scientific Inquiry	e.	Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
A.3.	Science in Practice	b.	Assess how scientific and technological progress has affected other fields of study, careers, and aspects of everyday life
		f.	Use a variety of appropriate sources (e.g., Internet, scientific journals) to retrieve relevant information; cite references properly
		h.	Explain how the contributions of basic science drive the potential of applied science (e.g., advantages found in nature can be emulated for our own benefit/product development, such as observations of gecko feet suggesting new adhesives; understanding of basic cell biology leading to cancer treatments)
C.1.	Genetics	a.	Describe the basic structure and function of DNA, mRNA, tRNA, amino acids, polypeptides, and proteins (e.g., replication, transcription, and translation)
		b.	Describe the experiments of major scientists in determining both the structure of DNA and the central dogma
		c.	Use mRNA codon charts to determine amino acid sequences of example polypeptides
		d.	Use mRNA codon charts to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation)
		e.	Describe how gene expression is regulated in organisms such that specific proteins are synthesized only when they are needed by the cell (e.g., allowing cell specialization)
		m.	Describe the mode of inheritance in commonly inherited disorders (e.g., sickle cell anemia, Down syndrome, Turner's syndrome, PKU)
		n.	Complete a major project relating to recombinant DNA, cloning, or stem cell research

Unit 12 Summary
Mendel's Peas: A Study of Mendelian Genetics

After examining historical models of inheritance, including the views of the Greeks, the concept of spontaneous generation, and the changes in research techniques and theories brought about by the advent of the microscope, students will be introduced to Gregor Mendel and his experiments with peas. By simulating Mendel's results, students will develop explanations to support Mendel's observations. Students will then study the discovery of chromosomes and meiosis and the relationship between meiosis and Mendel's observations.

ACT Course Standards

Unit 12 Mendel's Peas: A Study of Mendelian Genetics		
A.1.	Scientific Inquiry	c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
A.2.	Mathematics and Measurement in Science	c. Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.3.	Science in Practice	a. Describe the fundamental assumptions of science
		c. Recognize and apply criteria that scientists use to evaluate the validity of scientific claims and theories
		d. Explain why scientific explanations must meet certain criteria (e.g., be consistent with experimental/observational evidence about nature, be open to critique and modification, be subject to peer review, use ethical reporting methods and procedures)
		e. Explain why all scientific knowledge is subject to change as new evidence becomes available to the scientific community
C.1.	Genetics	f. Describe the basic process of meiosis
		g. Identify and explain Mendel's law of segregation and law of independent assortment
		h. Explain how the process of meiosis reveals the mechanism behind Mendel's conclusions about segregation and independent assortment on a molecular level
		i. Define and provide an example of the following: genotype, phenotype, dominant allele, recessive allele, codominant alleles, incompletely dominant alleles, homozygous, heterozygous, and carrier
		j. Explain sex-linked patterns of inheritance in terms of some genes being absent from the smaller Y chromosome, and thus males (XY) having a different chance of exhibiting certain traits than do females (XX)
		k. Construct and interpret Punnett squares and pedigree charts (e.g., calculate and predict phenotypic and genotypic ratios and probabilities)
		l. Infer parental genotypes and phenotypes from offspring data presented in pedigree charts and from the phenotypic and genotypic ratios of offspring
D.1.	Evolution	a. Describe the experiments of Redi, Needham, Spallanzani, and Pasteur to support or falsify the hypothesis of spontaneous generation
E.2.	Plants	a. Describe the basic mechanisms of plant processes, especially movement of materials and plant reproduction
		b. Explain the functions of unique plant structures, including the cell wall, chloroplasts, and critical parts of the flower and the seed

Unit 12 Mendel's Peas: A Study of Mendelian Genetics (continued)		
D.2.	Application (From English 10 standards)	a. Use elements of speech forms—introduction, transitions, body, and conclusion—including the use of facts, literary quotations, anecdotes, and/or references to authoritative sources
		c. Give impromptu and planned presentations (e.g., debates, formal meetings) that stay on topic and/or adhere to prepared notes
		f. Apply analytic and active listening strategies (e.g., paraphrasing, monitoring messages for clarity, selecting and organizing essential information, noting change-of-pace cues) in formal and informal settings
		g. Actively participate in small-group and large-group discussions, assuming various roles
E.	Study Skills and Test Taking (From English 10 standards)	a. Apply active reading, listening, and viewing techniques by taking notes on classroom discussions, lectures, oral and/or video presentations, or assigned at-home reading, and by underlining key passages and writing comments in journals or in margins of texts, where permitted

Unit 13
Beaks, Beans, and M&M's®: A Study of Natural Selection

ACT Course Standards

Unit 13 Beaks, Beans, and M&M's®: A Study of Natural Selection		
A.1.	Scientific Inquiry	a. Identify and clarify biological research questions and design experiments
		b. Manipulate variables in experiments using appropriate procedures (e.g., controls, multiple trials)
		c. Collect, organize, and analyze data accurately and precisely (e.g., using scientific techniques and mathematics in experiments)
		d. Interpret results and draw conclusions, revising hypotheses as necessary and/or formulating additional questions or explanations
		e. Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics
		f. Safely use laboratory equipment and techniques when conducting scientific investigations
A.2.	Mathematics and Measurement in Science	a. Use appropriate SI units for length, mass, time, temperature, quantity, area, volume, and density, and describe the relationships among SI unit prefixes (e.g., centi-, milli-, kilo-) and how SI units are related to analogous English units
		b. Calculate the mean of a set of values
		c. Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
A.4.	Foundations	c. Design and conduct investigations appropriately using essential processes of scientific inquiry
		d. Use mathematics to enhance the scientific inquiry process (e.g., choosing appropriate units of measurement, graphing and manipulating experimental data)
D.1.	Evolution	b. Explain the biological definition of evolution
		d. Discuss Darwin's principle of survival of the fittest, and explain what Darwin meant by natural selection
		e. Explain the influences of other scientists (e.g., Malthus, Wallace, Lamarck, Lyell) and of Darwin's trip on HMS *Beagle* in formulating Darwin's ideas about natural selection
		g. Provide examples of behaviors that have evolved through natural selection (e.g., migration, courtship rituals)
		h. Design, perform, and analyze a laboratory simulation of natural selection on a working population (e.g., teacher chooses prey items [hard candy, marshmallows]; students choose feeding adaptation [fork, toothpick, spoon] and hunt; students record results and then change prey or adaptation; and students analyze results using statistical methods)
		j. Describe the basic types of selection, including disruptive, stabilizing, and directional
		k. Explain how natural selection and its evolutionary consequences (e.g., adaptation or extinction) provide a scientific explanation for the fossil record of ancient life-forms and the striking molecular similarities observed among the diverse species of living organisms
A.2.	Reading Strategies (From English 10 standards)	a. Apply strategies before, during, and after reading to increase fluency and comprehension (e.g., adjusting purpose, previewing, scanning, making predictions, comparing, inferring, summarizing, using graphic organizers) with increasingly challenging texts
		b. Use metacognitive skills (i.e., monitor, regulate, and orchestrate one's understanding) when reading increasingly challenging texts, using the most appropriate "fix-up" strategies (e.g., rereading, reading on, changing rate of reading, subvocalizing)
D.2.	Application (From English 10 standards)	g. Actively participate in small-group and large-group discussions, assuming various roles

Unit 14
Evolution of Early Earth and Speciation

ACT Course Standards

Unit 14 Evolution of Early Earth and Speciation			
D.1.	Evolution	a.	Describe the experiments of Redi, Needham, Spallanzani, and Pasteur to support or falsify the hypothesis of spontaneous generation
		b.	Explain the biological definition of evolution
		c.	Differentiate among chemical evolution, organic evolution, and the evolutionary steps along the way to aerobic heterotrophs and photosynthetic autotrophs
		f.	Contrast Lamarck's and Darwin's ideas about changes in organisms over time
		g.	Provide examples of behaviors that have evolved through natural selection (e.g., migration, courtship rituals)
		i.	Specifically describe the conditions required to be considered a species (e.g., reproductive isolation, geographic isolation)
		k.	Explain how natural selection and its evolutionary consequences (e.g., adaptation or extinction) provide a scientific explanation for the fossil record of ancient life-forms and the striking molecular similarities observed among the diverse species of living organisms
		l.	Discuss evidence from the fields of geology, biochemistry, embryology, comparative anatomy, and comparative physiology that points to shared evolutionary relationships
		m.	Explain how Earth's life-forms have evolved from earlier species as a consequence of interactions of (a) the potential of a species to increase its numbers and (b) genetic variability of offspring due to mutation and recombinations of DNA
		n.	Distinguish between catastrophism, gradualism, and punctuated equilibrium

Unit 15
Relationships Among Organisms

ACT Course Standards

Unit 15 Relationships Among Organisms			
A.2.	Mathematics and Measurement in Science	c.	Use graphical models, mathematical models, and simple statistical models to express patterns and relationships determined from sets of scientific data
E.3.	Relationships Among Organisms	a.	Explain how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships
		b.	List each of the major levels in the hierarchy of taxa: kingdom, phylum, class, order, family, genus, and species
		c.	Explain the binomial nomenclature system
		d.	Construct and use a dichotomous taxonomic key
		e.	Distinguish between and among viruses, bacteria, and protists, and give examples of each
		f.	Explain classification criteria for fungi, plants, and animals
		g.	Compare the major divisions of animals

Unit 16
Animals

ACT Course Standards

Unit 16 Animals		
E.1.	Animals	a. Identify major types of animal cells and tissues
		b. Describe the major components and functions of physiological systems, including skeletal, muscle, circulatory, respiratory, digestive, urinary, endocrine, nervous, reproductive, and immune

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