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Grade Level(s):	9th - 12th Grade
Intended Audience:	Science 9-12th Standards Map for the Discipline BIOLOGY

**Standards Map - Basic Comprehensive Program
Grades Nine Through Twelve - Science**

Pursuant to the State Board approved, *Science Content Standards for California Public Schools, Kindergarten Through Grade Twelve*
Standards that all students are expected to achieve in the course of their studies are unmarked.
Standards that all students should have the opportunity to learn are marked with an asterisk (*).

Grade	Standard #	Text of Standard	PUBLISHER CITATIONS**			Meets Standard		FOR LEA USE ONLY Local Education Agency Evaluator Notes
			Introduced	Practiced	Taught to Mastery	Y	N	
DISCIPLINE		BIOLOGY/LIFE SCIENCES						
		Cell Biology The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:						
9-12	1a	Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.	SE: 207-208	SE: 207-208, 211-216	SE: 207-208, 211-216			
9-12	1b	Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.	SE: 262	SE: 262-267	SE: 262-267			
9-12	1c	Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	SE: 208-211	SE: 208-211	SE: 208-211			
9-12	1d	Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.	SE: 335-337	SE: 335-337, 344-346	SE: 335-337, 344-346			
9-12	1e	Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.	SE: 209	SE: 209	SE: 209			

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					Y	N		
9-12	1f	Students know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.	SE: 38-40	SE: 38-40, 81-88, 129-130	SE: 38-40, 81-88, 129-130			
9-12	1g	Students know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.	SE: 209	SE: 209	SE: 209			
9-12	1h	Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.	SE: 262, 329-337	SE: 262, 329-337	SE: 262, 329-337			
9-12	1i*	Students know how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.	SE: 39, 209	SE: 39, 209	SE: 39, 209			
9-12	1j*	Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.	SE: 209-210	SE: 209-210, 214, 216	SE: 209-210, 214, 216			

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						Y	N	
		Genetics Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:	SE: 292, 344	SE: 292, 303, 304, 343-346, 432	SE: 292, 303, 304, 343-346, 432			
9-12	2a	Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.	SE: 292	SE: 292, 299-303	SE: 292, 299-303			
9-12	2b	Students know only certain cells in a multicellular organism undergo meiosis.	SE: 304, 305	SE: 304, 305	SE: 304, 305			
9-12	2c	Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.	SE: 301-303	SE: 301-303, 310-311, 318-320, 343-344	SE: 301-303, 310-311, 318-320, 343-344			
9-12	2d	Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).	SE: 291	SE: 291, 292, 301, 304, 305	SE: 291, 292, 301, 304, 305			
9-12	2e	Students know why approximately half of an individual's DNA sequence comes from each parent.	SE: 291	SE: 291, 292, 301, 304, 305	SE: 291, 292, 301, 304, 305			
9-12	2f	Students know the role of chromosomes in determining an individual's sex.	SE: 290-292	SE: 290-292	SE: 290-292			
9-12	2g	Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.	SE: 316-320	SE: 316-320, 339	SE: 316-320, 339			
9-12	3	A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:	SE: 310-311	SE: 310-323, 326	SE: 310-323, 326			

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					Y	N		
9-12	3a	Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).	SE: 312-315	SE: 312-316, 318-320, 322-323, 326, 339	SE: 312-316, 318-320, 322-323, 326, 339			
9-12	3b	Students know the genetic basis for Mendel's laws of segregation and independent assortment.	SE: 316-317	SE: 316-317	SE: 316-317			
9-12	3c*	Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.	SE: 310	SE: 310, 312-315	SE: 310, 312-315			
9-12	3d*	Students know how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes.	SE: 321	SE: 321	SE: 321			
9-12	4	Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept:	SE: 284	SE: 284, 329-338, 344-346	SE: 284, 329-338, 344-346			
9-12	4a	Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.	SE: 330-331	SE: 330-331, 335-337	SE: 330-331, 335-337, 344-346			
9-12	4b	Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.	SE: 335-337	SE: 335-337, 344-346	SE: 335-337, 344-346			

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9-12	4c	Students know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.	SE: 338	SE: 338, 344-346	SE: 338, 344-346			
9-12	4d	Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.	SE: 307, 309	SE: 307, 309	SE: 307, 309			
9-12	4e	Students know proteins can differ from one another in the number and sequence of amino acids.	SE: 335-337	SE: 335-337	SE: 335-337			
9-12	4f*	Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.	SE: 338	SE: 338, 344-346	SE: 338, 344-346			
9-12	5	The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:	SE: 349-352	SE: 349-352	SE: 349-352			
9-12	5a	Students know the general structures and functions of DNA, RNA, and protein.	SE: 329-337	SE: 329-337, 344-346	SE: 329-337, 344-346			
9-12	5b	Students know how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.	SE: 329-335	SE: 329-335	SE: 329-335			
9-12	5c	Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.	SE: 352	SE: 352	SE: 352			

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9-12	5d*	Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.	SE: 349-352	SE: 349-352	SE: 349-352			
9-12	5e*	Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.	SE: 349-352	SE: 349-352	SE: 349-352			
		Ecology Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:						
9-12	6a	Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.	SE: 426	SE: 426-427, 430, 437	SE: 426-427, 430, 437, 443-445, 460-461			
9-12	6b	Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.	SE: 105-106	SE: 105-106, 426-427, 428-430, 443-445	SE: 105-106, 426-427, 428-430, 443-445, 462-464, 473-479			
9-12	6c	Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.	SE: 157-160	SE: 157-160, 162-165	SE: 157-160, 162-165, 176-178, 182-186, 187-188			
9-12	6d	Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.	SE: 26	SE: 26, 38-39, 40, 88, 91-93	SE: 26, 38-39, 40, 88, 91-93			

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				Y	N			
9-12	6e	Students know a vital part of an ecosystem is the stability of its producers and decomposers.	SE: 5	SE: 5, 19-20, 28-31	SE: 5, 19-20, 28-31			
9-12	6f	Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.	SE: 99-103	SE: 99-103, 502-503	SE: 99-103, 502-503			
9-12	6g*	Students know how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.	SE: 380-381	SE: 380-381, 432, 458-459	SE: 380-381, 432, 458-459			
		Evolution The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:						
9-12	7a	Students know why natural selection acts on the phenotype rather than the genotype of an organism.	SE: 380-381	SE: 380-381, 458-459	SE: 380-381, 458-459			
9-12	7b	Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.	SE: 310-311	SE: 310-311, 312-315, 315-316, 318-330, 381	SE: 310-311, 312-315, 315-316, 318-330, 381			
9-12	7c	Students know new mutations are constantly being generated in a gene pool.	SE: 344	SE: 344-346, 478	SE: 344-346, 478			
9-12	7d	Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.	SE: 458, 478	SE: 458, 478	SE: 458, 478			

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						Y	N	
9-12	7e*	Students know the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.	N/A	N/A	N/A			
9-12	7f*	Students know how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes.	N/A	N/A	N/A			
9-12	8	Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:	SE: 27	SE: 27, 380-381, 432-433, 456-459	SE: 27, 380-381, 432-433, 456-459			
9-12	8a	Students know how natural selection determines the differential survival of groups of organisms.	SE: 380-381	SE: 380-381, 456, 458-459, 478	SE: 380-381, 456, 458-459, 478			
9-12	8b	Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.	SE: 426, 462-464	SE: 426, 462-464	SE: 426, 462-464			
9-12	8c	Students know the effects of genetic drift on the diversity of organisms in a population.	SE: 478	SE: 478	SE: 478			
9-12	8d	Students know reproductive or geographic isolation affects speciation.	SE: 440-441	SE: 440-441	SE: 440-441			
9-12	8e	Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.	SE: 457	SE: 457	SE: 457			
9-12	8f*	Students know how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships.	SE: 436-439	SE: 436-439, 441-442	SE: 436-439, 441-442			
9-12	8g*	Students know how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.	SE: 438 (can be introduced with a discussion of phylogeny)	SE: 438 (can be introduced with a discussion of phylogeny)	SE: 438 (can be introduced with a discussion of phylogeny)			
		Physiology As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:						

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						Y	N	
9-12	9a	Students know how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.	SE: 200	SE: 200, 228-235, 237-240	SE: 200, 228-235, 237-240			
9-12	9b	Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.	SE: 240	SE: 240, 373-375, 386-391, 392-398, 407-412	SE: 240, 373-375, 386-391, 392-398, 407-412			
9-12	9c	Students know how feedback loops in the nervous and endocrine systems regulate conditions in the body.	SE: 200-201	SE: 200-201, 240-241, 304, 306, 308	SE: 200-201, 240-241, 304, 306, 308			
9-12	9d	Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.	SE: 240	SE: 240, 373	SE: 240, 373			
9-12	9e	Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.	SE: 240	SE: 240, 373-375, 386-391, 392-398, 407-412	SE: 240, 373-375, 386-391, 392-398, 407-412			
9-12	9f*	Students know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts.	SE: 224-225	SE: 224-225, 262-265, 267	SE: 224-225, 262-265, 267			
9-12	9g*	Students know the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.	SE: 218-220	SE: 218-220	SE: 218-220			
9-12	9h*	Students know the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca ⁺² , and ATP.	SE: 391-392	SE: 391-392	SE: 391-392			
9-12	9i*	Students know how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.	SE: 201-202	SE: 201-202, 240-241, 304-305, 306-307, 308, 373	SE: 201-202, 240-241, 304-305, 306-307, 308, 373			
9-12	10	Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:	SE: 244-247	SE: 244-247, 267-268	SE: 244-247, 267-268			
9-12	10a	Students know the role of the skin in providing nonspecific defenses against infection.	SE: 430	SE: 430	SE: 430			

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9-12	10b	Students know the role of antibodies in the body's response to infection.	SE: 245-246	SE: 245-246, 267-268	SE: 245-246, 267-268			
9-12	10c	Students know how vaccination protects an individual from infectious diseases.	SE: 246	SE: 246	SE: 246			
9-12	10d	Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.	SE: 208-209, 210-211	SE: 208-209, 210-211, 243, 244-247, 248, 249	SE: 208-209, 210-211, 243, 244-247, 248, 249			
9-12	10e	Students know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.	SE: 243-244	SE: 243-244, 246-247	SE: 243-244, 246-247			
9-12	10f*	Students know the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.	SE: 244-246	SE: 244-246	SE: 244-246			
DISCIPLINE		INVESTIGATION AND EXPERIMENTATION Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:						

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9-12	1a	Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.	SE: 13-15	SE: 13-15, 29-30, 40-42, 49-53, 78-81, 82-84, 171-174, 176-178, 386-389, 453-455	SE: 13-15, 29-30, 40-42, 49-53, 78-81, 82-84, 171-174, 176-178, 386-389, 453-455			
9-12	1b	Identify and communicate sources of unavoidable experimental error.	SE: 48	SE: 48, 259, 400, 407, 413	SE: 48, 259, 400, 407, 413			
9-12	1c	Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.	SE: 48	SE: 48, 259, 400, 407, 413	SE: 48, 259, 400, 407, 413			
9-12	1d	Formulate explanations by using logic and evidence.	SE: 28-31	SE: 28-31, 78-81, 115-116, 120-121, 202-205, 260-265	SE: 28-31, 78-81, 115-116, 120-121, 202-205, 260-265, 392-396			
9-12	1e	Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.	SE: 159-160	SE: 159-160, 165, 546	SE: 159-160, 546			
9-12	1f	Distinguish between hypothesis and theory as scientific terms.	SE: 30 (Theory can be incorporated into the class discussion.)	SE: 30 (Theory can be incorporated into the class discussion.)	SE: 30 (Theory can be incorporated into the class discussion.)			
9-12	1g	Recognize the usefulness and limitations of models and theories as scientific representations of reality.	SE: 22-23	SE: 22-23, 35-38, 162-165, 243-244, 292-294, 299-301, 331-335	SE: 22-23, 35-38, 162-165, 243-244, 292-294, 299-301, 331-335			
9-12	1h	Read and interpret topographic and geologic maps.	SE: 3	SE: 3, 94-97, 476-477	SE: 3, 94-97, 476-477			
9-12	1i	Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).	SE: 13-17, 40-42, 49-53, 112-115, 506-507	SE: 143-145, 176-178, 428-433, 462-464, 466-467, 511	SE: 143-145, 176-178, 428-433, 462-464, 466-467			

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9-12	1j	Recognize the issues of statistical variability and the need for controlled tests.	SE: 27-28	SE: 27-31, 54-55, 78-81, 135	SE: 27-31, 54-55, 78-81, 135			
9-12	1k	Recognize the cumulative nature of scientific evidence.	SE: 19	SE: 19, 27-28, 316-317, 441-442, 456-459	SE: 19, 27-28, 316-317, 456-459			
9-12	1l	Analyze situations and solve problems that require combining and applying concepts from more than one area of science.	SE: 31-39 (Chem)	SE: 31-39, 52-55 (Chem), 82-88 (Physics), 157-160, 171-174 (Math), 262-267 (Chem), 405-407 (Psych)	SE: 31-39, 52-55 (Chem), 82-88 (Physics), 157-160, 171-174 (Math), 262-267 (Chem), 405-407 (Psych)			
9-12	1m	Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.	SE: 56-61	SE: 56-61, 66-67, 126-127, 156, 191-192, 282-283, 355, 492-496, 501	SE: 56-61, 66-67, 126-127, 156, 191-192, 282-283, 355, 492-496, 501			
9-12	1n	Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).	SE: 442, 457-458	SE: 442, 457-458	SE: 442, 457-458			

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