

## Biology CR

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
3	Characteristic and Interactions of Living Organisms		
3.1	There is a fundamental unity underlying the diversity of all living organisms		
3.1.B	Organisms progress through life cycles unique to different types of organisms		
3.1.B.a	Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development		
3.1.B.b	Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism		
3.1.C	Cells are the fundamental units of structure and function of all living things		
3.1.C.a	Recognize all organisms are composed of cells, the fundamental units of structure and function	Cell Structure	Introduction
3.1.C.b	Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosome, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information,	Cell Structure	Section 1, Parts 5-9

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	photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism		
3.1.E	Biological classifications are based on how organisms are related		
3.1.E.a	Explain how similarities used to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development)	Biological Diversity	Section 1, Parts 4-7
3.1.E.b	Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon	Biological Diversity	Section 1, Part 8
3.2	Living organisms carry out life processes in order to survive		
3.2.A	The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means	Cell Structure	Section 1, Part 7
3.2.A.a	Compare and contrast the structure and function of mitochondria and chloroplasts	Cell Structure	Section 1, Parts 8-9
3.2.A.b	Compare and contrast the structure and function of cell wall and cell membranes	Cell Structure	Section 1, Part 9

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3.2.A.c	Explain physical and chemical interactions that occur between organelles (e.g. nucleus, cell membrane, chloroplast, mitochondrion, ribosome) as they carry out life processes	Cell Structure	Section 1, Parts 6-9
3.2.B	Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth		
3.2.B.a	Explain the interrelationship between the processes of photosynthesis and cellular respiration (e.g., recycling of oxygen and carbon dioxide), comparing and contrasting photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions)	Photosynthesis	Section 3, Part 13
3.2.B.b	Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)		
3.2.D	Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds		
3.2.D.a	Summarize how energy transfer occurs during photosynthesis and cellular respiration as energy is stored in and released from the bonds of chemical compounds (i.e. ATP)	Photosynthesis	Section 1, Parts 1-3
3.2.D.b	Relate the structure of organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) to their role in living systems	Nature of Science	Section 2, Parts 13-21
3.2.D.c	Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds	Photosynthesis	Section 1, Part 1

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3.2.D.d	Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules, growth and repair, regulation)	Photosynthesis	Section 1, Parts 6-8
3.2.D.e	Interpret a data table showing the effects of an enzyme on a biochemical reaction		
3.2.E	Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule		
3.2.E.a	Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis	Genetics	Section 4, Parts 1-2
3.2.E.b	Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)	Nature of Science	Section 2, Part 20
3.2.F	Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis)		
3.2.F.a	Explain the significance of the selectively permeable membrane to the transport of molecules	Cell Structure	Section 1, Part 6
3.2.F.b	Predict the movement of molecules across a selectively permeable membrane (i.e., diffusion, osmosis, active transport) needed for a cell to maintain homeostasis given concentration gradients and different sizes of molecules	Cell Structure	Section 2, Parts 3-8

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3.2.F.c	Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)	Nature of Science	Section 2, Parts 9-11
3.3	There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes		
3.3.A	Reproduction can occur asexually or sexually		
3.3.A.a	Distinguish between asexual (i.e., binary fission, budding, cloning) and sexual reproduction	Animal Organization	Section 10, Part 1
3.3.B	All living organisms have genetic material (DNA) that carries hereditary information		
3.3.B.a	Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome)	Genetics	Section 4, part 3
3.3.B.b	Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism	Genetics	Section 4, Part 1

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3.3.B.c	Recognize that degree of relatedness can be determined by comparing DNA sequences		
3.3.B.d	Explain how an error in the DNA molecule (mutation) can be transferred during replication		
3.3.B.e	Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., altered proteins which may affect chemical reactions and structural development)		
3.3.C	Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parent to offspring during reproduction		
3.3.C.a	Recognize the chromosomes of daughter cells, formed through the processes of asexual reproduction and mitosis, the formation of somatic (body) cells in multicellular organisms, are identical to the chromosomes of the parent cell	Cell Structure	Section 3, Parts 1-2
3.3.C.b	Recognize that during meiosis, the formation of sex cells, chromosomes are reduced to half the number present in the parent cell	Cell Structure	Section 4, Part 4
3.3.C.c	Explain how fertilization restores the diploid number of chromosomes	Cell Structure	Section 4, Part 7
3.3.C.d	Identify the implications of human sex chromosomes for sex determination	Genetics	Section 3, Part 3

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3.3.D	There is heritable variation within every species of organism		
3.3.D.a	Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population	Cell Structure	Section 4, Part 7
3.3.D.b	Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)	Cell Structure	Section 4, Part 7
3.3.D.c	Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells	Cell Structure	Section 4, Part 7
3.3.E	The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics		
3.3.E.a	Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species	Genetics	Section 1, Part 9
3.3.E.b	Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross	Genetics	Section 1, Part 7
3.3.E.c	Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender	Genetics	Section 3, Part 13

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4	Changes in Ecosystems and Interactions of Organisms with their Environments		
4.1	Organisms are interdependent with one another and with their environment		
4.1.A	All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem	Ecology	Section 2, Part 1
4.1.A.a	Explain the nature of interactions between organisms in predator/prey relationships and different symbiotic relationships (i.e., mutualism, commensalisms, parasitism)		
4.1.A.b	Explain how cooperative (e.g., symbiotic) and competitive (e.g., predator/prey) relationships help maintain balance within an ecosystem		
4.1.A.c	Explain why no two species can occupy the same niche in a community	Ecology	Section 2, Part 6
4.1.B	Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite		
4.1.B.a	Identify and explain the limiting factors (biotic and abiotic) that may affect the carrying capacity of a population within an ecosystem	Ecology	Section 1, Part 5

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4.1.B.b	Predict how populations within an ecosystem may change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors	Ecology	Section 1, Part 5
4.1.C	All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem		
4.1.C.a	Devise a multi-step plan to restore the stability and/or biodiversity of an ecosystem when given a scenario describing the possible adverse effects of human interactions with that ecosystem (e.g., destruction caused by direct harvesting, pollution, atmospheric changes)		
4.1.C.b	Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents)		
4.1.D	The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes		
4.1.D.a	Predict the impact (beneficial or harmful) a natural or human caused environmental event (e.g., forest fire, flood, volcanic eruption, avalanche, acid rain, global warming, pollution, deforestation, introduction of an exotic species) may have on the diversity of different species in an ecosystem	Ecology	Section 3, Part 18
4.1.D.b	Describe possible causes of extinction of a population	Ecology	Section 3, Part 17

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4.2	Matter and energy flow through the ecosystem		
4.2.A	As energy flows through the ecosystem, all organisms capture a portion of that energy and transform it to a form they can use		
4.2.A.a	Illustrate and describe the flow of energy within a food web	Ecology	Section 2, Part 8
4.2.A.b	Explain why there are generally more producers than consumers in an energy pyramid	Ecology	Section 2, Parts 8-9
4.2.A.c	Predict how the use and flow of energy will be altered due to changes in a food web		
4.2.B	Matter is recycled through an ecosystem		
4.2.B.a	Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem	Ecology	Section 3, Parts 2 and 4-5
4.2.B.b	Explain the importance of the recycling of nitrogen, oxygen, and carbon within an ecosystem	Ecology	Section 3, Parts 2 and 4-5

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4.3	Genetic variation sorted by the natural selection process explains evidence of biological evolution		
4.3.A	Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record		
4.3.A.a	Interpret fossil evidence to explain the relatedness of organisms using the principles of superposition and fossil correlation	History of Life on Earth	Section 1, Part 1
4.3.A.b	Evaluate the evidence that supports the theory of biological evolution (e.g., fossil records, similarities between DNA and protein structures, similarities between developmental stages of organisms, homologous and vestigial structures)	Evolution	Section 1, Parts 5-7
4.3.B	Reproduction is essential to the continuation of every species		
4.3.B.a	Define a species in terms of the ability to mate and produce fertile offspring	Ecology	Section 1, Part 1
4.3.B.b	Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that species)	Evolution	Section 1, Part 3
4.3.C	Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem		

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4.3.C.a	Identify examples of adaptations that may have resulted from variations favored by natural selection (e.g., long-necked giraffes, long-eared jack rabbits) and describe how that variation may have provided populations an advantage for survival	Evolution	Section 1, Part 6
4.3.C.b	Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)		
4.3.C.c	Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection	Evolution	Section 2, Part 4
4.3.C.d	Given a scenario describing an environmental change, hypothesize why a given species was unable to survive		
7	Scientific Inquiry		
7.1	Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking		
7.1.A	Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation		
7.1.A.a	Formulate testable questions and hypotheses	Nature of Science	Scientific Method Lab

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7.1.A.b	Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment	Nature of Science	Scientific Method Lab
7.1.A.c	Design and conduct a valid experiment	Nature of Science	Scientific Method Lab
7.1.A.d	Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)		
7.1.A.e	Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies		
7.1.A.f	Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations		
7.1.A.g	Evaluate the design of an experiment and make suggestions for reasonable improvements	Nature of Science	Scientific Method Lab
7.1.B	Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations		

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7.1.B.a	Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)	Nature of Science	Scientific Method Lab
7.1.B.b	Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second		
7.1.B.c	Determine the appropriate tools and techniques to collect, analyze, and interpret data	Nature of Science	Scientific Method Lab
7.1.B.d	Judge whether measurements and computation of quantities are reasonable		
7.1.B.e	Calculate the range, average/mean, percent, and ratios for sets of data		
7.1.B.f	Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)	Nature of Science	Scientific Method Lab
7.1.C	Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) light of evidence (data) and scientific principle (understandings)		

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7.1.C.a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)	Nature of Science	Scientific Method Lab
7.1.C.b	Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)		
7.1.C.c	Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)	Nature of Science	Scientific Method Lab
7.1.C.d	Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)		
7.1.D	The nature of science relies upon communication of results and justification of explanations		
7.1.D.a	Communicate the procedures and results of investigations and explanations through:		
7.1.D.a.1	oral presentations		
7.1.D.a.2	drawings and maps		

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7.1.D.a.3	data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities)	Nature of Science	Scientific Method Lab
7.1.D.a.4	graphs (bar, single, and multiple line)	Nature of Science	Scientific Method Lab
7.1.D.a.5	equations and writings		
7.1.D.b	Communicate and defend a scientific argument	Nature of Science	Scientific Method Lab
7.1.D.c	Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		
8	Impact of Science, Technology and Human Activity		
8.1	The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs		

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8.1.B	Advances in technology often result in improved data collection and an increase in scientific information		
8.1.B.a	Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)		
8.2	Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time		
8.2.A	People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations		
8.2.A.a	Recognize contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups		
8.2.A.b	Recognize gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology		
8.2.B	Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity		
8.2.B.a	Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., cell theory, theories of	Evolution	Section 1, Parts 1-3

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	spontaneous generation and biogenesis, theories of extinction, evolution theory, structure of the cell membrane, genetic theory of inheritance)		
8.2.B.b	Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution, extinction, global warming)		
8.3	Science and technology affect, and are affected by, society		
8.3.B	Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology		
8.3.B.a	Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges)		
8.3.B.b	Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)		

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8.3.B.c	Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, use of alternative energies for carbon fuels, use of pesticides)		
8.3.C	Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent		
8.3.C.a	Identify and evaluate the need for informed consent in experimentation		
8.3.C.b	Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)		
8.3.C.c	Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution on aquatic plants)		
8.3.D	Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible		

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8.3.D.a	Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)		
8.3.D.b	Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society	Nature of Science	Scientific Method Lab