State of Michigan & Keystone National High School
Alignment Document

Biology

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
B	Biology		
B1	Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.		
B1.1	Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct		

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	observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.		
B1.1A	Generate new questions that can be investigated in the laboratory or field.		
B1.1B	Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.	Biology and You	Textbook reading p.14-20
B1.1C	Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity-length, volume, weight, time interval, temperature-with the appropriate level of precision).		
B1.1D	Identify patterns in data and relate them to theoretical models.		
B1.1E	Describe a reason for a given conclusion using evidence from an investigation.	Biology and You	Textbook reading p.18 “Drawing Conclusions” and “Viewing Conclusions in Context”
B1.1f	Predict what would happen if the variables, methods, or timing of an investigation were changed.		
B1.1g	Use empirical evidence to explain and critique the reasoning used to draw a scientific conclusion or explanation.		
B1.1h	Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.		

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B1.1i	Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.	Biology and You	Textbook reading p.19 “Scientific Explanations”
B1.2	The integrity of the scientific process depends on scientists and citizens understanding and respecting the "nature of science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.		
B1.2A	Critique whether or not specific questions can be answered through scientific investigations.		
B1.2B	Identify and critique arguments about personal or societal issues based on scientific evidence.		

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B1.2C	Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.	Research Paper	Biology Part 1 Research Paper
B1.2D	Evaluate scientific explanations in a peer review process or discussion format.		
B1.2E	Evaluate the future career and occupational prospects of science fields.		
B1.2f	Critique solutions to problems, given criteria and scientific constraints.		
B1.2g	Identify scientific tradeoffs in design decisions and choose among alternative solutions.		
B1.2h	Describe the distinctions between scientific theories, laws, hypotheses, and observations.	Biology and You	Textbook reading p.19-20 “Scientific Explanations”
B1.2i	Explain the progression of ideas and explanations that leads to science theories that are part of the current scientific consensus or core knowledge.	Biology and You	Textbook reading p.19-20 “Scientific Explanations”
B1.2j	Apply science principles or scientific data to anticipate effects of technological design decisions.		

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B1.2k	Analyze how science and society interact from a historical, political, economic, or social perspective.	All Lessons	Most chapters in the textbook have a "BioWatch" article discussing these types of topics
B2	Students describe the general structure and function of cells. They can explain that all living systems are composed of cells and that organisms may be unicellular or multicellular. They understand that cells are composed of biological macromolecules and that the complex processes of the cell allow it to maintain a stable internal environment necessary to maintain life. They make predictions based on these understandings.		
L2.p1	All organisms are composed of cells, from just one cell to many cells. Water accounts for more than two-thirds of the weight of a cell, which gives cells many of their properties. In multicellular organisms, specialized cells perform specialized functions. Organs and organ systems are composed of cells and function to serve the needs of organisms for food, air, and waste removal. The way in which cells function is similar in all living organisms.		
L2.p1A	Distinguish between living and nonliving systems. (prerequisite)	Biology and You	p.6-7 of the online lesson
L2.p1B	Explain the importance of both water and the element carbon to cells. (prerequisite)	Chemistry of Life	Textbook readings p.31 "Water in Living Things" and p.34-37 "Chemistry of Cells"
L2.p1C	Describe growth and development in terms of increase in cell number, cell size, and/or cell products. (prerequisite)		

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L2.p1D	Explain how the systems in a multicellular organism work together to support the organism. (prerequisite)	Introduction to Body Structure	Textbook readings p.848 “Organ Systems”
L2.p1E	Compare and contrast how different organisms accomplish similar functions (e.g., obtain oxygen for respiration, and excrete waste). (prerequisite)	Photosynthesis and Cellular Respiration	This entire lesson revolves around how autotrophs use photosynthesis for energy production and heterotrophs use cellular respiration to release energy
L2.p2	Cells carry out the many functions needed to sustain life. They grow and divide, thereby producing more cells. Food is used to provide energy for the work that cells do and is a source of the molecular building blocks from which needed materials are assembled.		
L2.p2A	Describe how organisms sustain life by obtaining, transporting, transforming, releasing, and eliminating matter and energy. (prerequisite)	Photosynthesis and Cellular Respiration	Entire lesson
L2.p2B	Describe the effect of limiting food to developing cells. (prerequisite)		
L2.p3	Plants are producers; they use the energy from light to make sugar molecules from the atoms of carbon dioxide and water. Plants use these sugars, along with minerals from the soil, to form fats, proteins, and carbohydrates. This food can be used immediately, incorporated into the cells of a plant as the plant grows, or stored for later use.		
L2.p3A	Explain the significance of carbon in organic molecules. (prerequisite)	Chemistry of Life	Textbook readings p.34 “Carbon Compounds”

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L2.p3B	Explain the origins of plant mass. (prerequisite)	Introduction to Plants	Textbook readings p.502 “Establishment of Plants on Land”
L2.p3C	Predict what would happen to plants growing in low carbon dioxide atmospheres. (prerequisite)	Photosynthesis and Cellular Respiration	Textbook readings p.97-103 “Photosynthesis”
L2.p3D	Explain how the roots of specific plants grow. (prerequisite)	Plant Structure and Function	Textbook readings p.555 “Roots”
L2.p4	All animals, including humans, are consumers; they obtain food by eating other organisms or their products. Consumers break down the structures of the organisms they eat to obtain the materials they need to grow and function. Decomposers, including bacteria and fungi, use dead organisms or their products for food. (prerequisite)		
L2.p4A	Classify different organisms based on how they obtain energy for growth and development. (prerequisite)	Introduction to the Kingdoms of Life	Entire lesson covers this standard.
L2.p4B	Explain how an organism obtains energy from the food it consumes. (prerequisite)	Populations and Ecosystems	Textbook readings p.345-349 “Energy Flow in Ecosystems”
L2.p5	Living systems are made of complex molecules that consist mostly of a few elements, especially carbon, hydrogen, oxygen, nitrogen, and phosphorous. (prerequisite)	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”

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L2.p5A	Recognize the six most common elements in organic molecules (C, H, N, O, P, S). (prerequisite)	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
L2.p5B	Identify the most common complex molecules that make up living organisms. (prerequisite)	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
L2.p5C	Predict what would happen if essential elements were withheld from developing cells. (prerequisite)		
B2.1	In multicellular organisms, cells are specialized to carry out specific functions such as transport, reproduction, or energy transformation.		
B2.1A	Explain how cells transform energy (ultimately obtained from the sun) from one form to another through the processes of photosynthesis and respiration. Identify the reactants and products in the general reaction of photosynthesis.	Photosynthesis and Cellular Respiration	Covered throughout the entire lesson.
B2.1B	Compare and contrast the transformation of matter and energy during photosynthesis and respiration.	Photosynthesis and Cellular Respiration	Covered throughout the entire lesson.
B2.1C	Explain cell division, growth, and development as a consequence of an increase in cell number, cell size, and/or cell products.	Chromosomes and Cell Reproduction	Textbook readings p.125-127 “The Cell Cycle”
B2.1x	Following fertilization, cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo.	Reproduction and Development	Textbook readings p.1004 “Fertilization”

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B2.1d	Describe how, through cell division, cells can become specialized for specific function.		
B2.1e	Predict what would happen if the cells from one part of a developing embryo were transplanted to another part of the embryo.		
B2.2	There are four major categories of organic molecules that make up living systems: carbohydrates, fats, proteins, and nucleic acids.		
B2.2A	Explain how carbon can join to other carbon atoms in chains and rings to form large and complex molecules.	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
B2.2B	Recognize the six most common elements in organic molecules (C, H, N, O, P, S).	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
B2.2C	Describe the composition of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
B2.2D	Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”
B2.2E	Describe how dehydration and hydrolysis relate to organic molecules.		
B2.2x	Protein molecules are long, usually folded chains composed mostly of amino acids and are made of C, H, O, and N. Protein molecules assemble fats and carbohydrates;	Chemistry of Life	Textbook readings p.36 “Proteins”

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	they function as enzymes, structural components, and hormones. The function of each protein molecule depends on its specific sequence of amino acids and the shape of the molecule.		
B2.2f	Explain the role of enzymes and other proteins in biochemical functions (e.g., the protein hemoglobin carries oxygen in some organisms, digestive enzymes, and hormones).	Chemistry of Life	Textbook readings p.40-42 “Enzymes”
B2.2g	Propose how moving an organism to a new environment may influence its ability to survive and predict the possible impact of this type of transfer.	Populations and Ecosystems	This standard is covered throughout the entire lesson
B2.3	The internal environment of living things must remain relatively constant. Many systems work together to maintain stability. Stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.		
B2.3A	Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions.	Cell Structure	Textbook readings p.55 “Cell Features”
B2.3B	Describe how the maintenance of a relatively stable internal environment is required for the continuation of life.	Biology and You	Textbook readings p.8 “Homeostasis”
B2.3C	Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.		
B2.3x	The internal environment of living things must remain relatively constant. Many systems work together to maintain homeostasis. When homeostasis is lost, death occurs.	Biology and You	Textbook readings p.8 “Homeostasis”

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B2.3d	Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.	Unit 6: Human Biology	Each of the lessons and chapters under this unit cover a different body system in which this standard is covered.
B2.3e	Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar).	Unit 6: Human Biology	Each of the lessons and chapters under this unit cover a different body system in which this standard is covered.
B2.3f	Explain how human organ systems help maintain human health.	Unit 6: Human Biology	Each of the lessons and chapters under this unit cover a different body system in which this standard is covered.
B2.3g	Compare the structure and function of a human body system or subsystem to a nonliving system (e.g., human joints to hinges, enzyme and substrate to interlocking puzzle pieces).	Unit 6: Human Biology	Each of the lessons and chapters under this unit cover a different body system in which this standard is covered.
B2.4	In multicellular organisms, specialized cells perform specialized functions. Organs and organ systems are composed of cells and function to serve the needs of cells for food, air, and waste removal. The way in which cells function is similar in all living organisms.		
B2.4A	Explain that living things can be classified based on structural, embryological, and molecular (relatedness of DNA sequence) evidence.	Classification of Organisms	Textbook readings p.305-310 “How Biologists Classify Organisms”
B2.4B	Describe how various organisms have developed different specializations to accomplish a particular function and yet the end result is the same (e.g., excreting nitrogenous wastes in animals, obtaining oxygen for respiration).	Unit 5: Animal Kingdom	Each lesson/chapter in this unit covers a different animal which discusses this standard.

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B2.4C	Explain how different organisms accomplish the same result using different structural specializations (gills vs. lungs vs. membranes).	Unit 5: Animal Kingdom	Each lesson/chapter in this unit covers a different animal which discusses this standard.
B2.4d	Analyze the relationships among organisms based on their shared physical, biochemical, genetic, and cellular characteristics and functional processes.	Unit 5: Animal Kingdom	Each lesson/chapter in this unit covers a different animal which discusses this standard.
B2.4e	Explain how cellular respiration is important for the production of ATP (build on aerobic vs. anaerobic).	Photosynthesis and Cellular Respiration	Textbook readings p.104-110 “Cellular Respiration”
B2.4f	Recognize and describe that both living and nonliving things are composed of compounds, which are themselves made up of elements joined by energy-containing bonds, such as those in ATP.		
B2.4g	Explain that some structures in the modern eukaryotic cell developed from early prokaryotes, such as mitochondria, and in plants, chloroplasts.		
B2.4h	Describe the structures of viruses and bacteria.	Viruses and Bacteria	The entire lesson/chapter covers this standard.
B2.4i	Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.	Viruses and Bacteria	Textbook readings p.436 “Viral Reproduction”
B2.5	All living or once-living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds that also store energy.	Chemistry of Life	Textbook readings p.34-37 “Chemistry of Cells”

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B2.5A	Recognize and explain that macromolecules such as lipids contain high energy bonds.	Chemistry of Life	Textbook readings p.35 “Lipids”
B2.5B	Explain how major systems and processes work together in animals and plants, including relationships between organelles, cells, tissues, organs, organ systems, and organisms. Relate these to molecular functions.		
B2.5C	Describe how energy is transferred and transformed from the Sun to energy-rich molecules during photosynthesis.	Photosynthesis and Cellular Respiration	Textbook readings p.97-103 “Photosynthesis”
B2.5D	Describe how individual cells break down energy-rich molecules to provide energy for cell functions.	Photosynthesis and Cellular Respiration	Textbook readings p.104-107 “Cellular Respiration”
B2.5x	All living or once living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds that also store energy. However, that energy must be transferred to ATP (adenosine triphosphate) to be usable by the cell.	Chemistry of Life	Textbook Readings p.34-37 “Chemistry of Cells”
B2.5e	Explain the interrelated nature of photosynthesis and cellular respiration in terms of ATP synthesis and degradation.	Photosynthesis and Cellular Respiration	The entire lesson covers this standard throughout.
B2.5f	Relate plant structures and functions to the process of photosynthesis and respiration.	Photosynthesis and Cellular Respiration	The entire lesson covers this standard throughout.
B2.5g	Compare and contrast plant and animal cells.	Cell Structure	Textbook readings p.66 “Structures of Plant Cells”

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B2.5h	Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, and active transport).	Cell Structure	Textbook readings p.60-61 “The Cell Membrane”
B2.5i	Relate cell parts/organelles to their function.	Cell Structure	Textbook readings p.62-66 “Cell Organelles”
B2.6x	Cellular processes are regulated both internally and externally by environments in which cells exist, including local environments that lead to cell differentiation during the development of multicellular organisms. During the development of complex multicellular organisms, cell differentiation is regulated through the expression of different genes.		
B2.6a	Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short- and long-term equilibrium.		
B2.r6b	Explain that complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Note that cell behavior can also be affected by molecules from other parts of the organism, such as hormones. (recommended)	Chromosomes and Cell Reproduction	Textbook readings p.126 “Control of the Cell Cycle”
B2.r6c	Recognize and explain that communication and/or interaction are required between cells to coordinate their diverse activities. (recommended)		
B2.r6d	Explain how higher levels of organization result from specific complex interactions of smaller units and that their maintenance requires a constant input of energy as well as new material. (recommended)		

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B2.r6e	Analyze the body's response to medical interventions such as organ transplants, medicines, and inoculations. (recommended)		
B3	Students describe the processes of photosynthesis and cellular respiration and how energy is transferred through food webs. They recognize and analyze the consequences of the dependence of organisms on environmental resources and the interdependence of organisms in ecosystems.		
L3.p1	Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and the nonliving factors that interact with them form ecosystems. (prerequisite)	Populations and Ecosystems	This lesson covers the standard throughout.
L3.p1A	Provide examples of a population, community, and ecosystem. (prerequisite)	Populations and Ecosystems	This lesson covers the standard throughout
L3.p2	Two types of organisms may interact with one another in several ways; they may be in a producer/consumer, predator/ prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions in the Environment”
L3.p2A	Describe common relationships among organisms and provide examples of producer/consumer, predator/ prey, or parasite/host relationship. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions in the Environment”

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L3.p2B	Describe common ecological relationships between and among species and their environments (competition, territory, carrying capacity, natural balance, population, dependence, survival, and other biotic and abiotic factors). (prerequisite)	Populations and Ecosystems	This standard is covered throughout the entire lesson.
L3.p2C	Describe the role of decomposers in the transfer of energy in an ecosystem. (prerequisite)	Populations and Ecosystems	Textbook readings p.345-347 “Energy Flow in Ecosystems”
L3.p2D	Explain how two organisms can be mutually beneficial and how that can lead to interdependency. (prerequisite)		
L3.p3	The number of organisms and populations an ecosystem can support depends on the biotic resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions of Organisms and Their Environment”
L3.p3A	Identify the factors in an ecosystem that influence fluctuations in population size. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions of Organisms and Their Environment”
L3.p3B	Distinguish between the living (biotic) and nonliving (abiotic) components of an ecosystem. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions of Organisms and Their Environment”
L3.p3C	Explain how biotic and abiotic factors cycle in an ecosystem (water, carbon, oxygen, and nitrogen). (prerequisite)	Populations and Ecosystems	Textbook readings p.350-354 “Cycling of Materials in Ecosystems”
L3.p3D	Predict how changes in one population might affect other populations based upon their relationships in a food web. (prerequisite)	Populations and Ecosystems	Textbook readings p.345-347 “Energy Flow in Ecosystems”

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L3.p4	All organisms cause changes in their environments. Some of these changes are detrimental, whereas others are beneficial. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions of Organisms and Their Environment”
L3.p4A	Recognize that, and describe how, human beings are part of Earth's ecosystems. Note that human activities can deliberately or inadvertently alter the equilibrium in ecosystems. (prerequisite)	Populations and Ecosystems	Textbook readings p.340 “Interactions of Organisms and Their Environment”
B3.1	Organisms acquire their energy directly or indirectly from sunlight. Plants capture the Sun's energy and use it to convert carbon dioxide and water to sugar and oxygen through the process of photosynthesis. Through the process of cellular respiration, animals are able to release the energy stored in the molecules produced by plants and use it for cellular processes, producing carbon dioxide and water.		
B3.1A	Describe how organisms acquire energy directly or indirectly from sunlight.	Photosynthesis and Cellular Respiration	This standard is covered throughout this entire lesson.
B3.1B	Illustrate and describe the energy conversions that occur during photosynthesis and respiration.	Photosynthesis and Cellular Respiration	This standard is covered throughout this entire lesson.
B3.1C	Recognize the equations for photosynthesis and respiration and identify the reactants and products for both.	Photosynthesis and Cellular Respiration	This standard is covered throughout this entire lesson.
B3.1D	Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.	Photosynthesis and Cellular Respiration	This standard is covered throughout this entire lesson.

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B3.1e	Write the chemical equation for photosynthesis and cellular respiration and explain in words what they mean.	Photosynthesis and Cellular Respiration	Textbook p.97 = Photosynthesis Textbook p.104 = Cellular Respiration
B3.1f	Summarize the process of photosynthesis.	Photosynthesis and Cellular Respiration	Textbook readings p.97-103 “Photosynthesis”
B3.2	The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in an ecosystem, some energy is stored in newly made structures, but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going.		
B3.2A	Identify how energy is stored in an ecosystem.		
B3.2B	Describe energy transfer through an ecosystem, accounting for energy lost to the environment as heat.	Populations and Ecosystems	Textbook readings p.345-347 “Energy Flow in Ecosystems”
B3.2C	Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.	Populations and Ecosystems	Textbook readings p.345-347 “Energy Flow in Ecosystems”
B3.3	As matter cycles and energy flows through different levels of organization of living systems-cells, organs, organisms, and communities-and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat.		

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	Matter and energy are conserved in each change.		
B3.3A	Use a food web to identify and distinguish producers, consumers, and decomposers and explain the transfer of energy through trophic levels.	Populations and Ecosystems	Textbook readings p.345-347 “Energy Flow in Ecosystems”
B3.3b	Describe environmental processes (e.g., the carbon and nitrogen cycles) and their role in processing matter crucial for sustaining life.	Populations and Ecosystems	Textbook readings p.350-354 “Cycling of Materials in Ecosystems”
B3.4	Although the interrelationships and interdependence of organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. The impact of the human species has major consequences for other species.		
B3.4A	Describe ecosystem stability. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one.	Populations and Ecosystems	Textbook readings p.343 “Change of Ecosystems Over Time”
B3.4B	Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment.		
B3.4C	Examine the negative impact of human activities.		

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B3.4x	Humans can have tremendous impact on the environment. Sometimes their impact is beneficial, and sometimes it is detrimental.		
B3.4d	Describe the greenhouse effect and list possible causes.		
B3.4e	List the possible causes and consequences of global warming.		
B3.5	Populations of living things increase and decrease in size as they interact with other populations and with the environment. The rate of change is dependent upon relative birth and death rates.		
B3.5A	Graph changes in population growth, given a data table.	Populations and Ecosystems	Textbook readings p.322-323 “Modeling Population Growth”
B3.5B	Explain the influences that affect population growth.	Populations and Ecosystems	Textbook readings p.322-323 “Modeling Population Growth”
B3.5C	Predict the consequences of an invading organism on the survival of other organisms.		
B3.5x	The shape of population growth curves vary with the type of organism and environmental conditions, such as availability of nutrients and space. As the population increases and resources become more scarce, the population usually stabilizes at the carrying capacity of that environment.	Populations and Ecosystems	Textbook readings p.322-323 “Modeling Population Growth”

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B3.5d	Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.	Unit 5: Animal Kingdom	This entire unit covers this standard by exploring various animal reproductive systems.
B3.5e	Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.		
B3.5f	Graph an example of exponential growth. Then show the population leveling off at the carrying capacity of the environment.	Populations and Ecosystems	Textbook readings p.322-323 “Modeling Population Growth”
B3.r5g	Diagram and describe the stages of the life cycle for a human disease-causing organism. (recommended)		
B4	Students recognize that the specific genetic instructions for any organism are contained within genes composed of DNA molecules located in chromosomes. They explain the mechanism for the direct production of specific proteins based on inherited DNA. Students diagram how occasional modifications in genes and the random distribution of genes from each parent provide genetic variation and become the raw material for evolution. Content Statements, Performances, and Boundaries		
L4.p1	Reproduction is a characteristic of all living systems; because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually. Other organisms reproduce sexually. (prerequisite)	Biology and You	Textbook reading p.7 “Reproduction”

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L4.p1A	Compare and contrast the differences between sexual and asexual reproduction. (prerequisite)	Meiosis and Sexual Reproduction	Textbook readings p.150 “Sexual and Asexual Reproduction”
L4.p1B	Discuss the advantages and disadvantages of sexual vs. asexual reproduction. (prerequisite)	Meiosis and Sexual Reproduction	Textbook readings p.150 “Sexual and Asexual Reproduction”
L4.p2	The characteristics of organisms are influenced by heredity and environment. For some characteristics, inheritance is more important. For other characteristics, interactions with the environment are more important. (prerequisite)		
L4.p2A	Explain that the traits of an individual are influenced by both the environment and the genetics of the individual. Acquired traits are not inherited; only genetic traits are inherited. (prerequisite)	Mendel and Heredity	Textbook readings p.177-179 “Complex Control of Characters”
B4.1	Hereditary information is contained in genes, located in the chromosomes of each cell. Cells contain many thousands of different genes. One or many genes can determine an inherited trait of an individual, and a single gene can influence more than one trait. Before a cell divides, this genetic information must be copied and apportioned evenly into the daughter cells.		
B4.1A	Draw and label a homologous chromosome pair with heterozygous alleles highlighting a particular gene location.		
B4.1B	Explain that the information passed from parents to offspring is transmitted by means of genes that are coded in DNA molecules. These genes contain the information for the production of proteins.	DNA: The Genetic Material	Textbook Readings p.190 “Identifying the Genetic Material”

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B4.1c	Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.	Mendel and Heredity	Textbook readings p.175-178 “Inheritance of Traits”
B4.1d	Explain the genetic basis for Mendel's laws of segregation and independent assortment.	Mendel and Heredity	Textbook readings p.169 “The Laws of Heredity”
B4.1e	Determine the genotype and phenotype of monohybrid crosses using a Punnett Square.	Mendel and Heredity	Textbook readings p.170-174 “Studying Heredity”
B4.2	The genetic information encoded in DNA molecules provides instructions for assembling protein molecules. Genes are segments of DNA molecules. Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.		
B4.2A	Show that when mutations occur in sex cells, they can be passed on to offspring (inherited mutations), but if they occur in other cells, they can be passed on to descendant cells only (noninherited mutations).		
B4.2B	Recognize that every species has its own characteristic DNA sequence.	DNA: The Genetic Material	Textbook readings p.190 “Identifying the Genetic Material”
B4.2C	Describe the structure and function of DNA.	DNA: The Genetic Material	Textbook readings p.194 “The Structure of DNA”

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B4.2D	Predict the consequences that changes in the DNA composition of particular genes may have on an organism (e.g., sickle cell anemia, other).	Mendel and Heredity	Textbook readings p.180-182 “Genetic Disorders”
B4.2E	Propose possible effects (on the genes) of exposing an organism to radiation and toxic chemicals.		
B4.2x	Protein synthesis begins with the information in a sequence of DNA bases being copied onto messenger RNA. This molecule moves from the nucleus to the ribosome in the cytoplasm where it is "read." Transfer RNA brings amino acids to the ribosome, where they are connected in the correct sequence to form a specific protein.	How Proteins are Made	This standard is covered throughout the entire lesson/chapter.
B4.2f	Demonstrate how the genetic information in DNA molecules provides instructions for assembling protein molecules and that this is virtually the same mechanism for all life forms.	How Proteins are Made	This standard is covered throughout the entire lesson/chapter.
B4.2g	Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.	How Proteins are Made	This standard is covered throughout the entire lesson/chapter.
B4.2h	Recognize that genetic engineering techniques provide great potential and responsibilities.	Gene Technology	Textbook reading p.228 “Genetic Engineering”
B4.r2i	Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes. (recommended)		
B4.3	Sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents.	Meiosis and Sexual Reproduction	Textbook readings p.146-147 “Meiosis and Genetic Variation”

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B4.3A	Compare and contrast the processes of cell division (mitosis and meiosis), particularly as those processes relate to production of new cells and to passing on genetic information between generations.	Chromosomes and Cell Reproduction Meiosis and Sexual Reproduction	These topics are covered in different lessons/chapters, but the standard is fully covered within a combination of both.
B4.3B	Explain why only mutations occurring in gametes (sex cells) can be passed on to offspring.		
B4.3C	Explain how it might be possible to identify genetic defects from just a karyotype of a few cells.		
B4.3d	Explain that the sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations from the offspring of two parents.	Meiosis and Sexual Reproduction	Textbook reading p.146-147 “Meiosis and Genetic Variation”
B4.3e	Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.	Meiosis and Sexual Reproduction	Textbook reading p.146-147 “Meiosis and Genetic Variation”
B4.3f	Predict how mutations may be transferred to progeny.		
B4.3g	Explain that cellular differentiation results from gene expression and/or environmental influence (e.g., metamorphosis, nutrition).		
B4.4x	Genetic variation is essential to biodiversity and the stability of a population. Genetic variation is ensured by the formation of gametes and their combination to form a zygote. Opportunities for genetic variation also occur during cell division when chromosomes exchange genetic material causing permanent changes in the DNA	Meiosis and Sexual Reproduction	Textbook reading p.146-147 “Meiosis and Genetic Variation”

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	sequences of the chromosomes. Random mutations in DNA structure caused by the environment are another source of genetic variation.		
B4.4a	Describe how inserting, deleting, or substituting DNA segments can alter a gene. Recognize that an altered gene may be passed on to every cell that develops from it and that the resulting features may help, harm, or have little or no effect on the offspring's success in its environment.	How Proteins are Made	Textbook reading p.219-220 “Mutations”
B4.4b	Explain that gene mutation in a cell can result in uncontrolled cell division called cancer. Also know that exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Mitosis and Cellular Reproduction	Textbook reading p.126 “Control of the Cell Cycle”
B4.4c	Explain how mutations in the DNA sequence of a gene may be silent or result in phenotypic change in an organism and in its offspring.		
B4.r5x	Recombinant DNA technology allows scientists in the laboratory to combine the genes from different sources, sometimes different species, into a single DNA molecule. This manipulation of genes using bacterial plasmids has been used for many practical purposes including the mass production of chemicals and drugs. (recommended)		
B4.r5a	Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes. (recommended)		
B4.r5b	Evaluate the advantages and disadvantages of human manipulation of DNA. (recommended)	Gene Technology	Textbook reading p.228 “Genetic Engineering”

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B5	Students recognize that evolution is the result of genetic changes that occur in constantly changing environments. They can explain that modern evolution includes both the concepts of common descent and natural selection. They illustrate how the consequences of natural selection and differential reproduction have led to the great biodiversity on Earth.		
L5.p1	Individual organisms with certain traits in particular environments are more likely than others to survive and have offspring. When an environment changes, the advantage or disadvantage of characteristics can change. Extinction of a species occurs when the environment changes and the characteristics of a species are insufficient to allow survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the Earth no longer exist. (prerequisite)		
L5.p1A	Define a species and give examples. (prerequisite)	Classification of Organisms	Textbook reading p. 305 “What is a Species?”
L5.p1B	Define a population and identify local populations. (prerequisite)	Populations and Ecosystems	Textbook reading p.320 “What is a Population?”
L5.p1C	Explain how extinction removes genes from the gene pool. (prerequisite)		

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L5.p1D	Explain the importance of the fossil record. (prerequisite)	The Theory of Evolution	Textbook reading p.283 “The Fossil Record”
L5.p2	Similarities among organisms are found in anatomical features, which can be used to infer the degree of relatedness among organisms. In classifying organisms, biologists consider details of internal and external structures to be more important than behavior or general appearance. (prerequisite)	Classifiction of Organisms	Textbook reading p.302 “Classifying Organisms”
L5.p2A	Explain, with examples, that ecology studies the varieties and interactions of living things across space while evolution studies the varieties and interactions of living things across time. (prerequisite)		
B5.1	The theory of evolution provides a scientific explanation for the history of life on Earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.	The Theory of Evolution	This entire lesson/chapter covers this standard.
B5.1A	Summarize the major concepts of natural selection (differential survival and reproduction of chance inherited variants, depending on environmental conditions).	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.1B	Describe how natural selection provides a mechanism for evolution.	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.1c	Summarize the relationships between present-day organisms and those that inhabited the Earth in the past (e.g., use fossil record, embryonic stages, homologous structures, chemical basis).		
B5.1d	Explain how a new species or variety originates through the evolutionary process of natural selection.		

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B5.1e	Explain how natural selection leads to organisms that are well suited for the environment (differential survival and reproduction of chance inherited variants, depending upon environmental conditions).	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.1f	Explain, using examples, how the fossil record, comparative anatomy, and other evidence supports the theory of evolution.	The Theory of Evolution	This lesson/chapter covers the standard throughout.
B5.1g	Illustrate how genetic variation is preserved or eliminated from a population through natural selection (evolution) resulting in biodiversity.		
B5.2x	Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descents branched.		
B5.2a	Describe species as reproductively distinct groups of organisms that can be classified based on morphological, behavioral, and molecular similarities.	Classification of Organisms	Textbook reading p.305 “What is a Species?”
B5.2b	Explain that the degree of kinship between organisms or species can be estimated from the similarity of their DNA and protein sequences.		
B5.2c	Trace the relationship between environmental changes and changes in the gene pool, such as genetic drift and isolation of subpopulations.	Populations and Ecosystems	Textbook reading p.326-332 “How Populations Evolve”
B5.r2d	Interpret a cladogram or phylogenetic tree showing evolutionary relationships among organisms. (recommended)		

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B5.3	Evolution is the consequence of natural selection, the interactions of (1) the potential for a population to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection from environmental pressure of those organisms better able to survive and leave offspring.		
B5.3A	Explain how natural selection acts on individuals, but it is populations that evolve. Relate genetic mutations and genetic variety produced by sexual reproduction to diversity within a given population.	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.3B	Describe the role of geographic isolation in speciation.		
B4.3C	Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.3d	Explain how evolution through natural selection can result in changes in biodiversity.	The Theory of Evolution	Textbook reading p.279-280 “Evolution by Natural Selection”
B5.3e	Explain how changes at the gene level are the foundation for changes in populations and eventually the formation of new species.		
B5.3f	Demonstrate and explain how biotechnology can improve a population and species.	Gene Technology	This entire lesson/chapter covers the standard.