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Mon./Qtr.	Content	HSCE	Essential Skills	Assessment	Vocabulary
Sem. 1 Sept.	**Nature of Science**	**B1.1A:** Generate new questions that can be investigated in the lab 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 the dependence on underlying assumptions. Design and conduct a systematic investigation that tests a hypothesis. **B1.1C:** Conduct scientific investigations using appropriate tools and techniques. **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. **B1.1f** : Predict what would happen if the variables, methods or timing of an investigation were changed. **B1.1g:** Using empirical evidence to explain and critique the reasoning used to draw conclusions. **B1.1h**: Design and conduct a systematic investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables. **B1.1i:** Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.	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.	Scientific Method Lab, Characteristics of Life Poster, Characteristics of Life activity, Metric System lab, Formal Lab Report, Beetle Lab,	Scientific Method Hypothesis Independent/ Dependent Variable Control/ Experimental Variable Characteristics of Life

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Mon./Qtr.	Content	HSCE	Essential Skills	Assessment	Vocabulary
Sept.	**Nature of Science**	**B1.2A:** Critique whether or not specific questions can be answered through scientific investigations. **B1.2B:** Identify and critique arguments about personal and societal issues based on scientific evidence. **B1.2C:** Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information. **B1.2D:** Evaluate scientific explanations in a peer review process or discussion format. **B1.2E:** Evaluate the future career and occupational prospects of scientific 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. **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. **B1.2j:** Apply science principles or scientific data to anticipate effects of technological design decisions. **B1.2k:** Analyze how science and society interact from a historical, political, economic, or social perspective.			

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Mon./Qtr.	Content	HSCE	Essential Skills	Assessment	Vocabulary
Sept./Oct.	**Biochemistry**	**B2.2 Organic Molecules** 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. Clarification: Carbon molecules are limited to those possessing single and double covalent bonds. **B2.2B:** Recognize the six most common elements in organic molecules. (C,H,N,O,P,S) **B2.2C:** Describe the composition of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).	In multicellular organisms, cells are specialized to carry out specific functions such as transport, reproduction, or energy transformation.	Pattern MatchingPattern Matching Activity, Enzyme Reaction Rate Lab, Organic Compounds Lab, Organic Compounds Chart, Dehydration synthesis/ hydrolysis paper, model demonstration, Organic Molecule Models, Unit Exam,	ATP, Carbohydrate, Catalyst, Chemical bond, Covalent bonds, DNA, Dehydration, Element, Enzyme, Hemoglobin, High energy bonds, Hormone, Hydrolysis, Lipid, Molecular energy, Nucleic acid, Protein, Protein structure, Polymers, RNA, Substrate

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Mon./Qtr.	Content	HSCE	Essential Skills	Assessment	Vocabulary
Sept./Oct.	**Biochemistry**	**B2.2D**: Explain the general structure and primary functions of the major complex organic molecules that compose living organisms. Clarification: Carbohydrates are limited to general structural formulas of simple sugars and polymers of those sugars and their functions as short- and long-term energy storage molecules as well as structural components of cell walls. Lipids are limited to general structural formulas of fats and cell membrane structures and their functions. Proteins are specified to be polymers of amino acids with a variety of functions. These functions are limited to include proteins that relate to structure, such as those found in parts of the cell membrane, muscle and connective tissue. A large number of proteins also exist as enzymes, controlling the biochemical activities of an organism. Nucleic acids, DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) are limited to their structure as polymers of nucleotide subunits which provide information storage for the biochemical identity of an organism. **B2.2E:** Describe how dehydration and hydrolysis relate to organic molecules. Clarification: Dehydration and hydrolysis reactions are limited to the understanding that dehydration links subunits together to make larger molecules, at the same time releasing water. Hydrolysis reactions are essentially the reverse of dehydration reactions, with water reacting with a large molecule to break it down into smaller subunits.			

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Sept./Oct.	**Biochemistry**	***B2.2x Proteins*** 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; 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). Clarification: Proteins serve a variety of purposes in cells and are limited to general understanding of enzymes as substrate-specific catalysts that speed up the rate of biochemical reactions and facilitate the breakdown of complex molecules. Also permissible are important functions that include transport of chemical messages and essential materials for the cell. ***B2.4 Cell Specialization*** 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. **B2.4f:** 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.			

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Sept./Oct.	**Biochemistry**	***B2.5 Living Organism Composition*** 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. **B2.5A:** Recognize and explain that macromolecules such as lipids contain high energy bonds. Clarification: High energy bonds are limited to those found commonly in biological molecules, such as carbon-hydrogen and those found in ATP. ***Exclusions:*** Primary, secondary, tertiary structure of proteins. Names, functional groups, and structural formulas of amino acids. Differentiation among types of amino acids: hydrophobic, hydrophilic. The term "nucleotide" if used in items should be followed by "(a subunit or DNA)" Structural formulas of monomers of fats, proteins, carbohydrates (fatty acids, amino acids, simple sugars). Specific names of enzymes and substrates.			
Oct./Nov.	**Cells**	***B2.4 Cell Specialization*** 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.	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.	Organelle Project, Cell Analogy assignment, Osmosis in Celery Demonstration, Potato Osmosis Lab, Cell Transport diagrams, Elodea Lab, Microscope Use Lab, Microscope Parts and Functions Quiz, Virtual Cell Internet Activity,	Active transport, Bacteria, Biological evolution, Cell function, Cell membrane, Cell wall, Cellular differentiation, Chloroplast, Chromosome, Cytoplasm, Deoxyribonucleic acid, Diffusion, Eukaryote, Genetic material, Golgi apparatus

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Oct./Nov.	Cells	**B2.4g:** Explain that some structures in the modern eukaryotic cell develop from early prokaryotes, such as mitochondria, and in plants, chloroplast (endosymbiotic theory) **B2.4h:** Describe the structures of viruses and bacteria. Clarification: Structures are limited to bacterial cell walls, cell membranes, DNA and cytoplasm. Viral structures are limited to genetic material (either DNA or RNA) and protein coat covering of the virus. **B2.4i:** Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells. ***B2.5 Living Organism Composition*** All living or once living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds and also store energy. **B2.5g:** Compare and contrast plant and animal cells. Clarification: Cellular structures are limited to cell membranes, cell walls, chloroplasts, cytoplasm, Golgi apparatus, mitochondria, nucleus, ribosomes, vacuoles. **B2.5h:** Explain the role of the cell membrane as a highly selective barrier (diffusion, osmosis and active transport) Clarification: Transport process are limited to those listed in the content expectation.			Golgi apparatus, Mitochondrion, Nucleus, Nucleated cell, Organelle, Osmosis, Passive transport, Photosynthesizing organism, Prokaryote, Protein, Ribosome, Vacuole, Virus

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Oct./Nov.	**Cells**	**B2.5i:** Relate cell parts/organelles to their function Clarification: Cellular structures are limited to cell membranes, cell walls, chloroplasts, cytoplasm, Golgi apparatus, mitochondria, nucleus, ribosomes, vacuoles. Exclusions: Specific examples of molecular transport across the cell membrane (e.g., oxygen and carbon dioxide by diffusion, glucose by facilitated diffusion) Names of cellular organelles except as follows: cell membrane, cell walls, chloroplasts, cytoplasm, Golgi apparatus, mitochondria, nucleus, ribosomes, vacuoles			
Nov.	**Photosynthesis/ Cellular Respiration**	***B2.1Transrormation of Matter and Energy in Cells*** In multi-cellular 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. Clarification: Explanation is limited to one way flow of energy from the Sun to organisms and energy transformations that occur in the processes of photosynthesis and respiration. Reactants and products may be identified either by chemical formula or name.	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.	Photosynthesis and Cellular Respiration role play/newscast, Photosynthesis analogy, Elodea photosynthesis lab, Fermentation respiration lab, Corresponding quizzes, Unit Exam,	Aerobic, Anaerobic, ATP, Breakdown of food molecules, Carbon dioxide, Cellular Respiration, Cellular Energy conversion, Chloroplast, Enzyme, Mitochondrion, Molecular Energy Organic compound, Organic compound synthese, Photosynthesis, Photosynthesizing organism, Potential Energy, Product, Reactant, Recombination of

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Nov.	**Photosynthesis/ Cellular Respiration**	**B2.1B:** Compare and contrast the transformation of matter and energy during photosynthesis and respiration. **B2.4** ***Cell Specialization*** 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. **B2.4e:** Explain how cellular respiration is important for the production of ATP (build on aerobic vs. anaerobic). Clarification: Explanation is limited to a comparison of energy production from the breakdown of food with oxygen (aerobic) or without oxygen (anaerobic). The explanation can include that the food molecule is more completely broken down when oxygen is present-a more complete “burning” of the food occurs-leading to more ATP production. Numbers of ATP, specific reactions of cellular respiration are not required. ***B2.5 Living Organism Composition*** 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.			chemical elements, Release of energy, Transforming, matter and/or energy, Fermentation

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Nov.	**Photosynthesis/ Cellular Respiration**	**B2.5 C:** Describe how energy is transferred and transformed from the Sun to energy-rich molecules during photosynthesis. Clarification: Energy-rich molecules are limited to simple carbohydrates produced during photosynthesis. **B2.5 D:** Describe how individual cells break down energy-rich molecules to provide energy for cell functions. Clarification: Mitochondria in cells have enzyme pathways that can break the chemical bonds in energy rich molecules (food) and the energy released is stored as chemical potential in ATP. The ATP is the "energy currency" used to "pay" for doing cell work such as muscle contraction, neuron function, synthesis of other molecules, etc. ***B2.5x Energy Transfer*** 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 to be useable by the cell. **B2.5e:** Explain the interrelated nature of photosynthesis and cellular respiration in terms of ATP synthesis and degradation. **B2.5f:** Relate plant structures and functions to the process of photosynthesis and respiration. Clarification: Explanation limited to plant cells containing both chloroplasts and mitochondria to function in the processes of photosynthesis and respiration.			

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Nov.	**Photosynthesis/ Cellular Respiration**	***B3.1 Photosynthesis and Respiration*** Organisms acquire their energy directly or indirectly from sunlight. Plants capture the Sun's energy and use if 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. **B3.1 B:** Illustrate and describe the energy conversions that occur during photosynthesis and respiration. Clarification: Illustrations may include flowcharts, graphic displays, or pictures. **B3.1C:** Recognize the equations for photosynthesis and respiration and identify the reactants and products for both. Clarification: The equation may be either words or formulas. C6H12O6 (glucose/sugar) + 6 O2 (oxygen) 6 CO2 (carbon dioxide) + 6 H2O (water). **B3.1D:** Explain how living organisms gain and use mass through the processes of photosynthesis and respiration. **B3.1e:** Write the chemical equation for photosynthesis and cellular respiration and explain in words what they mean. Clarification: The general form of the equations will be organized with the reactants on the left side of the equation and the products on the right, but they may consist of names of the participants and their chemical formulas.			

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Nov.	**Photosynthesis/ Cellular Respiration**	**B3.1f:** Summarize the process of photosynthesis. Clarification: Explanation limited to plants capturing the energy of sunlight to put together carbon and oxygen (from carbon dioxide) and hydrogen (from water) to make high potential energy organic molecules (glucose) and releasing oxygen (from water) as a by-product. Exclusions: Representations of specific detailed steps of synthesis and decomposition (e.g. intermediate steps and molecules) Light reactions, Calvin cycle, Krebs Cycle, glycolysis, or intermediate products in respiration and photosynthesis. Tracking particular atoms in elements (especially carbon) through the process of photosynthesis and cellular respiration.			
Dec.	**Embryology Cellular Organization**	***B2.1x Cell Differentiation*** 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	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	Internet activity, Quiz, Early embryonic development clay models, Homeostasis Project, Most Wanted Pathogen Project, Dissection of frogs, Immune response Paper model demonstration, Daphnia Lab, Corresponding quizzes, Unit Exam	Anatomical characteristic, Cellular differentiation, Gills, Lungs, Natural selection, Structural specialization, Cellular regulation, Embryo formation

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Dec.	**Embryology Cellular Organization**	**B2.1d:** Describe how, through cell division, cells can become specialized for specific function. Clarification: Limited to student recognition that the position of cells in early embryonic development influence their fate as tissue types. These influences may include chemical signals from neighboring cells or specialization due to the genetic switching on or off of genes within the cell that cause it to make products that, in turn, further influence specific developmental features. **B2.1e:** Predict what would happen if the cells from one part of a developing embryo were transplanted to another part of the embryo Clarification: Predictions are limited to understanding that the organism undergoes specific changes early in embryonic development that differentiate certain cells to become certain cell types. Before those events, cells can become any tissue type, after that, they are fated and no longer have that ability. ***B4.3 Cell Division-Mitosis and Meiosis*** Sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from offspring of any two parents.			

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Dec.	**Embryology Cellular Organization**	**B4.3g:** Explain that cellular differentiation results from gene expression and/or environmental influence (e.g., metamorphosis, nutrition). Clarification: Explanation is limited to general understanding that cell differentiation is the result of signals from inside the cell via genetic control and from external, environmental influences.			
Sem. 2 Jan./Feb.	**Organ Systems - Homeostatsis**	***B2.3 Maintaining Environmental Stability*** 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. Clarification: Descriptions will be limited to those listed in the content expectation (temperature and pH). **B2.3B:** Describe how the maintenance of a relatively stable internal environment is required for the continuation of life. Clarification: Systems involved in homeostasis will be limited to the nervous, digestive, immune, circulatory, respiratory and excretory systems of organisms. **B2.3C:** Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.	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.	Homeostasis Project Most Wanted Pathogen Project Dissection of frogs Immune response Paper model demonstration Daphnia Lab Corresponding quizzes Unit Exam	Behavioral response, Disease agents, Equilibrium, Homeostasis, Hormone Neuron, pH, Physiological change, Regulatory response

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Sem. 2 Jan./Feb.	**Organ Systems - Homeostatsis**	***B2.3x Homeostasis*** The internal environment of living things must remain relatively constant. Many systems work together to maintain homeostasis. When homeostasis is lost, death occurs. **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 one another. Clarification: General functions will not include detailed descriptions of organ tissue types, muscle and skeletal names, or the biochemistry of physiologic functions. **B2.3e:** Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar). Clarification: Mechanisms involved are limited to those pertaining to the examples listed in the content expectation. **B2.3f:** Explain how human organ systems help maintain human health. Clarification: Systems described are limited to those involved in nutrition, cardiovascular and respiratory health. **B2.3g:** Compare the structure and function of a human body system or subsystem to a nonliving system (e.g., human joints to hinges, enzymes and substrate to interlocking puzzle pieces).			

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Sem. 2 Jan./Feb.	**Organ Systems - Homeostatsis**	***B2.6x Internal/External Call Regulation*** 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. Clarification: The expectation is limited to explanation involving the nervous and immune systems and hormone control as governing response to external stimuli. ***B2.5 Living Organism Composition*** All living or once living organisms are composed of carbohydrates, lipids, proteins, and nucleic acids. Carbohydrates and lipids contain many carbon-hydrogen bonds and also store energy. **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. Clarification: Explanations are limited to the following systems and processes in plants and animals: how organisms use food/fuel, obtain gasses for metabolism, support themselves structurally, reproduce and excrete waste materials.			

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Feb./Mar.	**Mitosis and Meiosis**	***B3.5 Populations*** 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. **B3.5d**: Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages ***B4.2 DNA*** 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 passes on to offspring (inherited mutations), but if they occur in other cells, they can be passed on to descendent cells only (noninherited mutations) ***B4.3 Cell Division-Mitosis and Meiosis*** Sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from offspring of any two parents.	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. 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	Internet labs, Flip Books, Pipe cleaner Models, Microscope onion, root tip Mitosis Fish Blastula Meiosis Microscope lab Baby Rebop Lab Chemical/Physical change analogy Corresponding Quizzes Unit Exam	Cancer, Carcinogen, Chromosome, Crossing over, Deletion, DNA replication, Diploid, Duplication of genes, Gametes, Genetic variation, Haploid, Jumping genes, Karyotype, Meiosis, Mitosis, Mutation, New gene, combination, Progeny, Recombination of genetic material, Sex cell, Sex chromosomes Trisomy 21, Turner's Syndrome

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Feb./Mar.	**Mitosis and Meiosis**	**B4.3A:** Compare and contrast the processes of cell division (mitosis & meiosis), particularly as those processes relate to the production of new cells and to passing on genetic information between generations. Clarification: Limited to identification of pictures or diagrams of cell division and explanation that mitosis produces new body cells and meiosis is responsible for the production of sex cells and passing genetic information on to the next generation. **B4.3B:** Explain why only mutations occurring in gametes can be passed on to offspring. **B4.3C:** Explain how it might be possible to identify genetic defects from a karyotype of just a few cells. Clarification: Limited to identification of Down syndrome and Turner's syndrome as examples of genetic defects by comparing those karyotypes to a normal karyotype. **B4.3d:** Explain that the sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of two parents. Clarification: Recognize a diagram of meiosis and possible gene combinations that could occur through meiosis.			

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Feb./Mar.	**Mitosis and Meiosis**	**B4.3e:** Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes. Clarification: Limited to recognizing diagrams or pictures that illustrate crossing over, duplication or deletion of parts of chromosomes. **B4.3f:** Predict how mutations may be transferred to progeny. Clarification: Recognize how gene mutations such as sickle cell anemia and PKU can be passed on to offspring. ***B4.4x Genetic Variation*** Genetic Variation is essential to biodiversity formation if 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 sequences of the chromosomes. Random mutations in DNA structure caused by the environment are another source of genetic variation.			

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Feb./Mar.	**Mitosis and Meiosis**	**B4.4b:** Explain that gene mutation in a cell can result in uncontrolled cell division called cancer. Also know that exposure to certain chemicals and radiation increases mutation and thus increases the chance of cancer. Clarification: Limited to recognizing that gene mutations that control cell division cause cancer. These mutations can be passed on from parent to offspring, or more commonly can develop over the course of one's life due to exposure to chemicals and/or radiation. Exclusions: Names of stages of mitosis & meiosis are excluded, but representations of stages are included.			
Mar./April	**Genetics**	**B4.1** ***Genetics and Inherited Traits*** 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 chromosomes pair with Heterozygous alleles highlighting a particular gene location.	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	Solve probability problems, using Punnett squares, Vocabulary Quiz, Genetic Disease Pamphlet, Solve genetics story, Problems by, constructing Punnett squares, Pedigrees	Allele, Chromosome, Chromosome pair, Co-dominant traits, DNA replication, Dominant trait, Gene encoding, Gene expression, Genetic diversity, Gene location, Genetic mutation, Genetic variation, Genotype, Heterozygous, Homologous, chromosome, Human genetics, Independent assortment, Law of Segregation, Meiosis, Mendelian genetics, New gene combinations,

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Mar./April	**Genetics**	**B4.1c:** Differentiate between dominant, recessive, co-dominant, polygenic, and sex-linked traits. Clarification: Traits identified by definition (dominant traits are expressed if the allele is present, recessive traits only if the dominant alleles are missing, co-dominant in which both alleles are expressed, polygenic having more than one gene active in determining trait and sex-linked traits as alleles on X chromosome). Also included are interpretations of Punnett Square results, given that the trait is identified as one of those listed in the content expectation. Interpretation may include prediction of phenotype and genotype ratios. **B4.1d :**Explain the genetic basis for Mendel's laws of segregation and independent assortment. **B4.1e:** Determine the genotype and phenotype of monohybrid crosses using a Punnett Square. ***B4.2 DNA*** 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. **B4.2B:** Recognize that every species has its own characteristic DNA sequence.			Phenotype, Phylogenetics, Polygenic traits, Protein, Protein synthesis, Punnett Square, Recessive traits, Recombination of genetic material, Sex cell, Sex chromosomes, Sex-linked traits, Shared characteristics, Storage of genetic information

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Mar./April	**Genetics**	**B4.2h:** Recognize that genetic engineering techniques provide great potential and responsibilities. Clarification: Limited to understanding that genetic engineering is used currently to produce gene products such as human insulin. The great responsibility is making sure that altered genes don't upset natural ecosystems or cause human suffering. There are also ethical decisions regarding use of stem cells and cloning. Exclusions: PCR, Details of how electrophoreses works, Structures of nucleotides			
April	**Protein Synthesis**	**B4.1** ***Genetics and Inherited Traits*** 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.	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.	DNA Bracelet, DNA Alias, How DNA Determines Traits, Human applications, Translation and transcription paper, Model demonstration, Protein Synthesis role play, Animated translation video, Internet research Activity, Unit Test,	

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April	**Protein Synthesis**	**B4.1 B:** 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. ***B4.2 DNA*** 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. **B4.2C:** Describe the structure and function of DNA. Clarification: DNA exists as a double stranded helix, joined by a sequence of nucleotides (subunits of DNA) of four types in specific sequences. Content expectation is limited to complimentary sequencing and knowledge that sequences of DNA nucleotides "code" for the amino acid sequence of a protein.	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		

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April	**Protein Synthesis**	**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). Clarification: Expectation is limited to understanding that if DNA sequences changes, non-functioning proteins may result that lead to adverse effects in the organism or its offspring. These adverse effects may take the form of commonly inherited disorders such as sickle cell anemia, phenylketonuria or cystic fibrosis. **B4.2E:** Propose possible effects (on the genes) of exposing an organism to radiation and toxic chemicals. Clarification: Effects are limited to understanding that certain chemicals and environmental hazards may change the structure of the DNA, altering the instructional function of the DNA molecule to make correct proteins. ***B4.2x DNA, RNA, and Protein Synthesis*** 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.			

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April	**Protein Synthesis**	**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. Clarification: Demonstration is expected to use a DNA or messenger RNA coding chart to allow the code to be read and the correct amino acid to be identified. **B4.2g:,** Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology. Clarification: Content expectation is limited to understanding of replication of DNA by pairing of complementary nucleotides to exposed parent strands in the cell's nucleus. The expectation will not address directionality of the DNA strands. Content expectation is limited to understanding that transcription occurs in the nucleus and involves pairing of DNA nucleotides to RNA complementary nucleotides to form strands then released from the nucleus and travels to the cytoplasm, where it serves as a template for protein assembly. Content expectation is limited to understanding that translation is the process of taking the RNA strand formed in transcription and using it as a template for the assembly of amino acids, in sequence, to form a protein. **B4.2i :**Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes.			

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April	**Protein Synthesis**	***B4.4x Genetic Variation*** 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 sequences of the chromosomes. Random mutations in DNA structure caused by the environment are another source of genetic variation. **B4.4 a:** 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 of no effect on the offspring's success in its environment. Clarification: Recognize that only a cell that becomes a sex cell can pass these genetic changes on to the next generation. **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. Clarification: Limited to recognizing that gene mutations that control cell division cause cancer. These mutations can be passed on from parent to offspring, or more commonly can develop over the course of one's life due to exposure to chemicals and/or radiation.			

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April	**Protein Synthesis**	**B 4.4c:** 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. Exclusions: Structures of amino acids and Structures of nitrogen bases associated with DNA and RNA. ***B2.4 Cell Specialization*** 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.	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.	Vocabulary Quiz, Natural selection activity, "Fossil Find" activity, Abert vs. Kaibab Squirrel example, California Salamander activity, PBS evolution series website (Flashy Fish), Antibiotic resistance, Comparing amino acids sequencing in vertebrates	Behavioral structures, Biodiversity, Biological evolution, Chance inherited variants, Comparative anatomy, Degree of kinship, Differential survival, DNA, DNA molecule, Embryonic stages of development, Evidence for the unity among organisms, Gene pool, Genetic drift, Genetic diversity, Genetic mutation, Genetic variation, Homologous structures, Molecular structures, Morphological structures, Natural selection, Origin of life, Phylogenetics, Recombination of genetic material, Speciation

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May	**Evolution**	**B2.4 B:** 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). Clarification: Descriptions are limited to discussion of how the process of evolution through natural selection gave rise to different strategies for accomplishing the same result in widely varying species. **B2.4C:** Explain how different organisms accomplish the same result using different structural specializations (gills vs. lungs vs. membranes). Clarification: Structural designs that serve the same purpose in varying species are limited to the organs and organ systems that follow: digestion, skeletal, respiration, reproduction, and excretion. Organisms should include plants as well as animal structures (e.g., flowers, seeds, and fruits as reproductive structures) **B2.4d:** Analyze the relationships among organisms based on their shared physical, biochemical, genetic, and cellular characteristics and functional processes. Clarification – Explanations will be limited to given numerical estimates of DNA similarity between different groups of organisms as well as structural similarities.	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.		

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May	**Evolution**	***B3.4 Changes in Ecosystems*** 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 of more new species appear as a result of migration or local evolutions. The impact of the human species has major consequences for other species. **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. Clarification –Descriptions will be limited to relationship between biodiversity and genetic variation as indicators of stability within an ecosystem. ***B5.1 Theory of Evolution*** 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.			

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Mon./Qtr.	Content	HSCE	Essential Skills	Assessment	Vocabulary
May	**Evolution**	**B5.1A:** Summarize the major concepts of natural selection (differential survival and reproduction of chance inherited variants, depending on environmental conditions*). Clarification –Summary will be limited to 4 concepts: 1)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 resources required for life and 4) the ensuing selection from environmental pressure leaves some of those organisms better able to survive and leave offspring.* **B5.1B:** Describe how natural selection provides a mechanism for evolution. Clarification: Descriptions will be limited to the concepts of variation in inherited traits among offspring giving some an advantage in ability to survive and reproduce over offspring. **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. **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).			

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May	**Evolution**	**B5.1f:** Explain, using examples, how the fossil record, comparative anatomy, and other evidence supports the theory of evolution. **B5.1g:** Illustrate how genetic variation is preserved or eliminated from a population through natural selection (evolution) resulting in biodiversity. Clarification: Explanations are limited to advantages or disadvantages that are the result of new combinations of genetic material through sexual reproduction. Those offspring with new combinations that have advantages (more success in environment and increased numbers of offspring) will have access to more resources and eventually those with genetic disadvantages will be decreased or eliminated from the environment. ***B5.2x Molecular Evidence*** 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 structures. **B5.2b:** Explain that the degree of kinship between organisms or species can be estimated from 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.			
May	**Evolution**	***B5.3 Natural Selection*** Evolution is the consequence of natural selection, the			

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		B5.3A: Explain how natural selection acts on individuals, but it is populations that evolve. Relate genetic mutations and genetic variety **B5.3B**: Describe the role of geographic isolation in speciation. **B5.3C:** Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms. **B5.3d:** Explain how evolution through natural selection can result in changes in biodiversity. **B5.3e :** Explain how changes at the gene level are the foundation for changes in populations and eventually the formation of a new species. **B5.3f:** Demonstrate and explain how biotechnology can improve a population and species. Clarification - Explanations are limited to genetic modifications that allow a species to be more successful in its environment and ability to leave offspring.			
May/June	**Ecology**	***B2.2x Proteins*** 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; 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. **B2.2g**: 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.	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.	Invasive species project, Lesson of the Kaibob (carrying capacity), Smog City, Deadly Links Activity (food chain a and human impacts), Water/Soil Testing, Wolf/Moose Predator/Prey on Isle Royale, Oh Deer Activity, Inquiry Plant Lab,	Abiotic components of ecosystems, Biological molecule, Breakdown of food molecules, Carbon, Carbon cycle, Carbon dioxide, Cellular energy conversion, Cellular respiration, Chemical bond, Chemical organization of organisms, Consumer,

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May/June	**Ecology**	***B3.2 Ecosystems*** 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. Clarification: Identification is limited to discussion of chemical bonds as stored energy structures. **B3.2B**: Describe energy transfer through an ecosystem, accounting for energy lost to the environment as heat. Clarification: Descriptions are limited to non-numerical accounting of inefficiencies of energy transformations. **B3.2C**: Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed. Clarification: Drawings will not include numerical data, but will emphasize inefficient conversions as energy moves through the trophic levels. Predictions may include changes in populations of organisms at various trophic levels as energy available to			Energy requirements of living systems, Flow of energy, Flow of matter, Nitrogen cycle

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May/June	**Ecology**	***B3.3 Element Recombination*** As matter cycles and energy flows through different levels of organization of living systems-cells, organs, organism, 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. 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. **B3.3b**: Describe environmental processes (e.g., the carbon and nitrogen cycles) and their role in processing matter crucial for sustaining life. Clarification: Descriptions are limited to names of participants in the carbon and nitrogen cycles and how they are used by and cycled through organisms. ***B3.4 Changes in Ecosystems*** Although the interrelationships and ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one of more new species appear as a result of migration or local evolutions. The impact of the human species has major consequences for other species.	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.		

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May/June	**Ecology**	**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. **B3.4C**: Examine the negative impact of human activities. ***B3.4x Human Impact*** 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*** Populations of living things increase and decrease in assize as they interact with other populations and with the environment. The rate of change is dependent upon both relative birth and death rates. **B3.5A**: Graph changes in population growth, given a data table. **B3.5B**: Explain the influences that affect population growth.	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. 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.		

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May/June	**Ecology**	**B3.5C**: Predict the consequences of an invading organism on the survival of other organisms. Clarification: Predictions are limited to the effect of a non-native species on the populations of native species. ***B3.5x Environmental Factors*** 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. **B3.5e**: Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems. Clarification: Descriptions are limited to effects of abiotic factors (temperature, sunlight, pH, nutrient availability) on population dynamics. **B3.5f**: Graph an example of exponential growth. Then show the population leveling off at the carrying capacity of the environment. **B3.5g**: 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. *Clarification*: Predictions are limited to the effect of introducing a new species to an environment and the potential of this new species to be successful. Exclusions: Mathematical calculations of population change			