Michigan Standards for Teaching and Learning
Content Standards Mapping

BIOLOGY	Boardworks High School Biology Presentations
B2.1 Transformation of Matter and Energy in Cells	
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.	Aerobic Respiration Photosynthesis 1 Photosynthesis 2
B2.1b Compare and contrast the transformation of matter and energy during photosynthesis and respiration.	Aerobic Respiration Anaerobic Respiration Photosynthesis 1 Photosynthesis 2
B2.1c Explain cell division, growth, and development as a consequence of an increase in cell number, cell size, and/or cell products.	Cell Differentiation Development Meiosis Mitosis The Stages of Meiosis The Stages of Mitosis
B2.1x Cell Differentiation	
B2.1d Describe how, through cell division, cells can become specialized for specific function.	Cell Differentiation Specialized Plant Cells
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 Organic Molecules	
B2.2a Explain how carbon can join to other carbon atoms in chains and rings to form large and complex molecules.	–
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).	Lipids Monosaccharides Nucleic Acids Polysaccharides Proteins

B2.2d Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.	Lipids Monosaccharides Nucleic Acids Polysaccharides Proteins
B2.2e Describe how dehydration and hydrolysis relate to organic molecules.	–
B2.2x Proteins	
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).	Blood and Blood Vessels Digestion Enzymes Enzyme Shape Hormones Proteins
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.	Animal Adaptations Environmental Variation Evolution Extinction Homeostasis Plant Adaptations The Process of Evolution
B2.3 Maintaining Environmental Stability	
B2.3a Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions.	Enzymes Enzyme Shape Glucoregulation Homeostasis Thermoregulation
B2.3b Describe how the maintenance of a relatively stable internal environment is required for the continuation of life.	Enzymes Enzyme Shape Homeostasis Glucoregulation Thermoregulation The Kidneys

B2.3c Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.	Diabetes Glucoregulation Homeostasis Immune System Infectious Disease Thermoregulation
B2.3x Homeostasis	
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.	Blood and Blood Vessels Cells to Organisms Controlling Movement Digestion Female Reproductive System Hormones Immune System Immune Responses Nerve Impulses The Brain The Endocrine System The Kidneys The Nervous System The Respiratory System The Skeleton Types of Muscles Ventilation
B2.3e Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar).	Diabetes Glucoregulation Homoeostasis The Endocrine System The Kidneys Thermoregulation

B2.3f Explain how human organ systems help maintain human health.	Blood and Blood Vessels Cells to Organisms Diabetes Hormones Immune System Immune Responses The Kidneys The Respiratory Systems
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).	Enzyme Shape Enzymes The Skeleton
B2.4 Cell Specialization	
B2.4a Explain that living things can be classified based on structural, embryological, and molecular (relatedness of DNA sequence) evidence.	Classification
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).	Animal Adaptations Plant Adaptations
B2.4c Explain how different organisms accomplish the same result using different structural specializations (gills vs. lungs vs. membranes).	–
B2.4d Analyze the relationships among organisms based on their shared physical, biochemical, genetic, and cellular characteristics and functional processes.	Classification Eukaryotic Cells Prokaryotic cells
B2.4e Explain how cellular respiration is important for the production of ATP (build on aerobic vs. anaerobic).	Aerobic Respiration Anaerobic Respiration Cell Theory
B2.4f Recognize and describe that both living and non-living things are composed of compounds, which are themselves made up of elements joined by energy-containing bonds, such as those in ATP.	Cell Theory Lipids Monosaccharides Polysaccharides Proteins
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.	HIV and AIDS Prokaryotic Cells
B2.4i Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.	HIV and AIDS

B2.5 Living Organism Composition	
B2.5a Recognize and explain that macromolecules such as lipids contain high energy bonds.	Digestion Lipids Monosaccharides Polysaccharides
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.	Cells to Organisms Eukaryotic Cells Organelles
B2.5c Describe how energy is transferred and transformed from the Sun to energy-rich molecules during photosynthesis.	Photosynthesis 1 Photosynthesis 2
B2.5d Describe how individual cells break down energy-rich molecules to provide energy for cell functions.	Aerobic Respiration Anaerobic Respiration Digestion
B2.5x Energy Transfer	
B2.5e Explain the interrelated nature of photosynthesis and cellular respiration in terms of ATP synthesis and degradation.	Aerobic Respiration Photosynthesis 1 Photosynthesis 2
B2.5f Relate plant structures and functions to the process of photosynthesis and respiration.	Eukaryotic Cells Photosynthesis 1 Photosynthesis 2 Plant Adaptations Specialized Plant Cells
B2.5g Compare and contrast plant and animal cells.	Eukaryotic Cells Organelles
B2.5h Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, and active transport).	Active Transport Diffusion Eukaryotic Cells Osmosis Prokaryotic Cells The Fluid Mosaic Model
B2.5i Relate cell parts/organelles to their function.	Organelles Eukaryotic Cells Prokaryotic Cells

B2.6x Internal/External Cell Regulation	
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.	Behavior Glucoregulation Homeostasis The Endocrine System The Kidneys Thermoregulation
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.	Cell Differentiation Genetic Mutations Hormones Meiosis Mitosis The Stages of Mitosis
B2.r6c Recognize and explain that communication and/or interaction are required between cells to coordinate their diverse activities.	Hormones The Endocrine System
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.	Aerobic Respiration Cells to Organisms
B2.r6e Analyze the body's response to medical interventions such as organ transplants, medicines, and inoculations.	Antibodies and Vaccinations Blood Transfusions Vaccinations
B3.1 Photosynthesis and Respiration	
B3.1a Describe how organisms acquire energy directly or indirectly from sunlight.	Energy Transfer in Food Chains Food Chains Food Webs Photosynthesis 1 Photosynthesis 2
B3.1b Illustrate and describe the energy conversions that occur during photosynthesis and respiration.	Aerobic Respiration Photosynthesis 1 Photosynthesis 2
B3.1c Recognize the equations for photosynthesis and respiration and identify the reactants and products for both.	Aerobic Respiration Photosynthesis 1 Photosynthesis 2
B3.1d Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.	Energy Transfer in Food Chains Food Chains Photosynthesis 1 Photosynthesis 2

B3.1e Write the chemical equation for photosynthesis and cellular respiration and explain in words what they mean.	Aerobic Respiration Photosynthesis 2
B3.1f Summarize the process of photosynthesis.	Photosynthesis 2
B3.2 Ecosystems	
B3.2a Identify how energy is stored in an ecosystem.	Ecosystems Energy Loss in Food Chains Energy Transfer in Food Chains Food Chains Food Webs
B3.2b Describe energy transfer through an ecosystem, accounting for energy lost to the environment as heat.	Energy Loss in Food Chains Energy Transfer in Food Chains Food Chains Food Webs
B3.2c Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.	Ecosystems Energy Loss in Food Chains Energy Transfer in Food Chains Food Chains Food Webs
B3.3 Element Recombination	
B3.3a Use a food web to identify and distinguish producers, consumers, and decomposers and explain the transfer of energy through trophic levels.	Decomposers Food Chains Food Webs Energy Transfer in Food Chains
B3.3b Describe environmental processes (e.g. the carbon and nitrogen cycles) and their role in processing matter crucial for sustaining life.	Carbon Cycle Nitrogen Cycle Recycling Nutrients
B3.4 Changes in Ecosystems	
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.	Ecosystems and Succession
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.	Ecosystems Evolution Extinction Loss of Diversity Population Genetics The Process of Evolution

B3.4c Examine the negative impact of human activities.	Air Pollution Climate Change Human Impact on the Environment Loss of Diversity Over-fishing Water Pollution
B3.4x Human Impact	
B3.4d Describe the greenhouse effect and list possible causes.	Air Pollution Climate Change Fossil Fuels
B3.4e List the possible causes and consequences of global warming.	Air Pollution Climate Change Fossil Fuels
B3.5 Populations	
B3.5a Graph changes in population growth, given a data table.	Describing Populations
B3.5b Explain the influences that affect population growth.	Ecosystems Describing Populations
B3.5c Predict the consequences of an invading organism on the survival of other organisms.	Describing Populations
B3.5x Environmental Factors	
B3.5d Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.	Asexual Reproduction
B3.5e Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.	Ecosystems Ecosystems and Succession
B3.5f Graph an example of exponential growth. Then show the population leveling off at the carrying capacity of the environment.	Describing Populations
B3.r5g Diagram and describe the stages of the life cycle for a human disease-causing organism. (recommended)	HIV and AIDS
B4.1 Genetics and Inherited Traits	
B4.1a Draw and label a homologous chromosome pair with heterozygous alleles highlighting a particular gene location.	Genes and Alleles

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.	Controlling Protein Synthesis DNA Genes and Alleles Genetic Variation Meiosis Proteins Protein Synthesis Transcription and Translation
B4.1c Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.	Genes and Alleles Genetic Variation Incomplete Dominance and Codominance Inherited Diseases
B4.1d Explain the genetic basis for Mendel's laws of segregation and independent assortment.	Gregor Mendel Meiosis
B4.1e Determine the genotype and phenotype of monohybrid crosses using a Punnett Square.	Gregor Mendel
B4.2 DNA	
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).	Cell Differentiation DNA Replication 2 Inherited Diseases Meiosis
B4.2b Recognize that every species has its own characteristic DNA sequence.	Understanding Genomes
B4.2c Describe the structure and function of DNA.	DNA Nucleic Acids Understanding Genomes
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).	DNA Replication 2 Genetic Variation Inherited Diseases
B4.2e Propose possible effects (on the genes) of exposing an organism to radiation and toxic chemicals.	Genetic Mutations Genetic Variation Inherited Diseases
B4.2x DNA, RNA, and 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.	Controlling Protein Synthesis DNA Protein Synthesis Proteins Nucleic Acids Transcription and Translation
B4.2g Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.	Controlling Protein Synthesis DNA DNA Replication 1 Protein Synthesis Transcription and Translation
B4.2h Recognize that genetic engineering techniques provide great potential and responsibilities.	Genetic Engineering Genetic Engineering for Health Care
B4.r2i Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes.	–
B4.3 Cell Division — Mitosis and Meiosis	
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.	DNA Meiosis Mitosis The Stages of Meiosis The Stages of Mitosis
B4.3b Explain why only mutations occurring in gametes (sex cells) can be passed on to offspring.	Genetic Variation Inherited Disease Meiosis
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 Gregor Mendel Genetic Variation The Stages of Meiosis
B4.3e Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.	DNA Replication 2 Genetic Mutations Inherited Diseases Meiosis

B4.3f Predict how mutations may be transferred to progeny.	Gregor Mendel Inherited Diseases Meiosis The Stages of Meiosis
B4.3g Explain that cellular differentiation results from gene expression and/or environmental influence (e.g. metamorphosis, nutrition).	Cell Differentiation Controlling Protein Synthesis Environmental Variation
B4.4x 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.	DNA Replication 1 DNA Replication 2 Genetic Mutations Meiosis Mitosis
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.	Cell Differentiation Genetic Mutations
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.	DNA Replication 2 Inherited Diseases
B4.r5x Recombinant DNA	
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)	Genetic Engineering Genetic Engineering for Health Care GM Organisms
B5.1 Theory of Evolution	
B5.1a Summarize the major concepts of natural selection (differential survival and reproduction of chance inherited variants, depending on environmental conditions).	Darwin Evolution Extinction The Process of Evolution
B5.1b Describe how natural selection provides a mechanism for evolution.	Evolution Extinction The Process of Evolution
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).	Fossil Record
B5.1d Explain how a new species or variety originates through the evolutionary process of natural selection.	Evolution The Process of Evolution

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).	Animal Adaptations Evolution Extinction The Process of Evolution
B5.1f Explain, using examples, how the fossil record, comparative anatomy, and other evidence supports the theory of evolution.	Darwin Evolution Extinction Fossil Record
B5.1g Illustrate how genetic variation is preserved or eliminated from a population through natural selection (evolution) resulting in biodiversity.	Evolution Extinction Genes and Alleles Genetic Variation Introduction to Biodiversity The Process of Evolution
B5.2x Molecular Evidence	
B5.2a Describe species as reproductively distinct groups of organisms that can be classified based on morphological, behavioral, and molecular similarities.	Introduction to Biodiversity 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.	Population Genetics
B5.r2d Interpret a cladogram or phylogenetic tree showing evolutionary relationships among organisms.	–
B5.3 Natural Selection	
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.	Evolution Extinction The Process of Evolution
B5.3b Describe the role of geographic isolation in speciation.	Population Genetics
B4.3c Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.	Evolution The Process of Evolution
B5.3d Explain how evolution through natural selection can result in changes in biodiversity.	Evolution Extinction The Process of Evolution

B5.3e Explain how changes at the gene level are the foundation for changes in populations and eventually the formation of new species.	Evolution Genes and Alleles Genetic Variation Population Genetics The Process of Evolution
B5.3f Demonstrate and explain how biotechnology can improve a population and species.	GM Organisms Selective Breeding