Davison Community Schools
ADVISORY CURRICULUM COUNCIL
Phase II, March 17, 2015

Biology/Honors Biology

Course Essential Questions:

Big Idea 1 – The process of evolution drives the diversity and unity of life.

How does the process of evolution drive the diversity and unity of life?

Big Idea 2 – Biological systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.

How do biological systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis?

Big Idea 3 – Living systems store, retrieve, transmit, and respond to information essential to life processes.

How do living systems store, retrieve, transmit, and respond to information essential to life processes?

Big Idea 4 – Biological systems interact, these systems and their interactions possess complex properties.

How do biological systems interact, these systems and their interactions possess complex properties?

Phase II Curriculum

Unit 1: Characteristics of Life & Scientific Inquiry, Reflection, and Social Implications

Essential Questions:	**Essential Understandings:**
● **What are the characteristics of life?** ● **How are questions and problems answered using scientific inquiry?**	● **All living things are made of one or more cells, display organization, grow and develop, obtain and use energy, reproduce, maintain homeostasis, respond to stimuli, and can adapt and evolve.** ● **Questions and problems are solved using controlled experiments.** ● **Interpret and analyze experimental data to develop new questions, accept/reject hypotheses, and draw conclusions.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

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.

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.
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.
B1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.
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.
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 science fields.
B1.2f Critique solutions to problems, given criteria and scientific constraints

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: ● 1.adaptation: inherited characteristics of an organism that aids in survival and can change over time ● 2.Biology: science of life; examines how living things interact, how systems function and how they function at molecular level ● 3.constant/control: remains same during experiment, while the independent variable is changed ● 4.control group: group not receiving factor being tested in controlled experiment ● 5.data: quantitative/qualitative info gained from scientific investigation/experiment ● 6.dependent variable: what is measured in an experiment (plotted on y-axis) ● 7.development: changes before adulthood ● 8.ethics: set of values ● 9.experiment: used to test a hypothesis & and collect data ● 10.experimental group: controlled experiment, group receiving factor being tested ● 11.growth: new cells and structures formed; increase in mass ● 12.homeostasis: organisms maintenance of internal conditions (regulation) over time ● 13.hypothesis: testable explanation ● 14.independent variable: what is changed in an experiment (plotted on x-axis) ● 15.inference: assumption based on prior	● I can identify examples of the characteristics of life. ● I can generate examples for the characteristics of life. ● I can differentiate between living and non-living. ● I can generate a question to be answered using scientific inquiry. ● I can design and conduct a controlled experiment. ● I can develop a hypothesis to be tested. ● I can identify the independent and dependent variables in an experiment. ● I can create data tables and graphs. ● I can analyze data. ● I can distinguish between science and pseudoscience. ● I can critique the validity of scientific data. ● I can identify weaknesses in experimental design. ● I can identify reliable sources for peer review and research.

experience ● 16.law: fact of nature that describes relationship under certain conditions in nature ● 17.metric system: measurement system whose divisions are powers of ten ● 18.observation: orderly, direct information gathered about a natural phenomenon ● 19.organism: anything that has/once had all characteristics of life ● 20.organization: orderly structure (how organisms are put together/built) ● 21.peer review: procedures used during experiment may be repeated and the results are evaluated by scientists in same field/ similar research ● 22.reproduction: production of offspring ● 23.response: organisms reaction to stimulus ● 24.science: a body of knowledge based on study of nature ● 25.scientific method: series of problem solving procedures: ● observations, hypothesis, experiment, gather/analyze data, & conclusions ● 26.SI: system of measurements used by scientists abbreviation of international system of units ● 27.species: group of organisms that can interbreed and produce offspring ● 28.stimulus: internal/external change in environment; causes reaction ● 29.theory: explanation that is supported over time ● I know the characteristics of life. ● I know the process of scientific inquiry.	

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 2: Chemistry of Life

Essential Questions:	**Essential Understandings:**
● **What are the six most common elements of organic molecules in living things?** ● **What are the four organic molecules of life?** ● **What functions do the organic molecules provide in living things?** ● **How is matter conserved in living things?** ● **Why is water important to life?**	● **The six most common elements of organic molecules include carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur (CHNOPS).** ● **Carbohydrates, lipids, proteins, and nucleic acids comprise living things.** ● **Organic molecules provide and store energy, allow for growth/repair, speed up chemical reactions, and store and communicate genetic information.** ● **Matter is conserved according to law of conservation of matter.** ● **Water is essential to maintaining homeostasis in living things.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

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).

B2.2D Explain the general structure and primary functions of the major complex organic molecules that compose living organisms.

B2.2E Describe how dehydration and hydrolysis relate to organic molecules.

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).

B2.3A Describe how cells function in a narrow range of physical conditions, such as temperature and pH (acidity), to perform life functions.

B2.5A Recognize and explain that macromolecules such as lipids contain high energy bonds.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.acid: any substance that forms hydrogen ions (H+) in	● I can draw atom models. ● I can identify the proton, neutron, and electron

water, pH below 7; sour taste; turns blue litmus red; phenolphthalein remains clear; example: lemon juice
2.activation energy: the amount of energy needed to begin a chemical reaction
3.amino acid: building blocks of proteins; 20 amino acids
4.atom: smallest particle of an element that still retains the same characteristics of the element; made of neutrons, protons and electrons
5.base: any substance that forms hydroxide ions in water (OH-); pH above 7; bitter taste; slippery; turns red litmus blue; phenolphthalein turns pink; example: soap
6.buffers: substances that maintain certain pH levels
7.carbohydrate: macromolecule composed of carbon, hydrogen, and oxygen in a ratio of two hydrogen atoms to one carbon atom to one oxygen atom; starch, glycogen and cellulose
8.catalyst: substance that speeds chemical reactions by lowering the activation energy
9.chemical reaction: process that rearranges atoms to form different substances (reactants to products)
10.compound: composed of atoms of two or more different elements that are chemically combined; can be either covalent or ionic
11.covalent bond: a bond formed between two or more atoms by the sharing of electrons forming a molecule; examples include lipids, proteins and water
12.dehydration: a process that removes -OH from one monomer and H+ from another monomer to create water and a polymer
13.element: a substance that cannot be broken down into simpler chemical substances; composed of the same type of atoms
14.enzyme: protein, biological catalyst, that increases the rate of a chemical reaction; is not changed in reaction; affected by heat and pH; become denatured and will not function properly
15.hydrogen bond: weak chemical bond formed by the attraction between polar molecules
16.hydrolysis: a process that breaks bonds of a polymer to the individual monomers by taking the -OH and H+ from a water molecule and adding them to each monomer
17.ion: charged particle formed when one or more atoms gain or lose electrons
18.ionic bond: attractive force between two ions of opposite charge; example: salt, NaCl; Na+ has a positive charge and Cl- has a negative charge
19.isotope: atoms of the same element that have different number of neutrons; has the same number of protons; can be radioactive
20.lipid: macromolecule composed mostly of carbon and hydrogen atoms with a few oxygen atoms; examples include waxes, fats, oils and steroids; insoluble in water; make up part of cell membrane
21.macromolecules: large molecules, polymers, that are found in organisms (carbohydrates, lipids, proteins, nucleic acids)
22.metabolism: all of the chemical reactions that occur within an organism
23.mixture: combination of substances in which the

number in a given atom.

- I can draw and describe the three shapes carbon may take to form complex molecules.
- I can differentiate between ionic and covalent bonds.
- I can identify the 6 most common elements in organic molecules.
- I can identify the specific elements and their proportions in each of the organic molecules.
- I can describe the individual subunits in each of the organic molecules.
- I can recognize the structural formulas of each organic molecule.
- I can give examples of different organic molecules.
- I can summarize the major functions of each organic molecule.
- I can predict what would happen to my body if certain organic molecules were not available.
- I can describe where energy is stored in molecules.
- I can predict which molecule stores the most energy given its name, example or composition.
- I can differentiate between acids and bases.
- I can interpret the pH scale to describe the strength of acids and bases.
- I can describe the optimum temperature and pH conditions for a cell.
- I can give examples of what would happen to a cell if changes in pH or temperature occur.
- I can describe hydrolysis and dehydration.
- I can differentiate between reactants and products in a chemical reaction.
- I can describe the covalent structure of water.
- I can explain how water forms hydrogen bonds.
- I can differentiate between hydrolysis and dehydration reactions.
- I can identify how organic molecules are made using dehydration
- I can identify how organic molecules are broken down using hydrolysis
- I can summarize the functions of enzymes.
- I can label enzyme substrate complexes in dehydration and hydrolysis reactions.
- I can recognize the enzyme is not changed in a chemical reaction.
- I can explain that enzymes lower the activation energy to allow chemical reactions to proceed at a faster rate.

individual components retain their own properties; example - sugar in water or salt in water 24.molecule: group of atoms held together by covalent bonds; examples: glucose and water 25.monomer: building blocks of polymers; examples include monosaccharides, amino acids, nucleotides 26.nucleic acid: macromolecule that stores cellular information in the form of a code made of nucleotides; DNA and RNA are examples 27.nucleotide: monomers consisting of carbon, hydrogen, oxygen, nitrogen and phosphorus; building blocks of nucleic acids; three parts: nitrogenous base, simple sugar and a phosphate group 28.nucleus: center of an atom; contains the protons and neutrons; positively charged. Atomic mass is the combination of the neutrons and protons, atomic number is the number of protons only 29.peptide bond: covalent bond formed between amino acids; creates proteins 30.pH: measure of how acidic or basic a solution is; pH scale is from 0 to 14. 0 to 7 is acidic; 7 to 14 is basic; 7 is neutral 31.polar molecule: molecule with an unequal distribution of charge, resulting in the molecule having a positive end and a negative end. example - water 32.polymer: large molecule formed when many smaller molecules bond together; can be formed by dehydration 33.product: substance(s) that are created as a result of a chemical reaction 34.protein: macromolecule composed of carbon, hydrogen, oxygen, nitrogen and sometimes sulfur; building blocks are amino acids; enzymes; created at ribosomes 35.reactant: substances needed to start a chemical reaction 36.solution: a mixture in which one or more substances (solute) are distributed evenly in another substance (solvent); water is the universal solvent; example: sweet iced tea 37.substrate: reactants that bind to an enzyme 38.van der Waals forces: attraction between the positive and negative regions of molecules that hold them together (weak attraction) ● I know the six common elements that make up living things. ● I know the makeup and function of the four major categories of organic molecules. ● I know how dehydration and hydrolysis relate to organic molecules. ● I know the importance of water to living things. ● I know how temperature and pH affect the function of living things.	

Phase III Textbook/Materials

Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 3: Cell Structure and Function

Essential Questions:	**Essential Understandings:**
● **How do cells maintain homeostasis?** ● **What are the cellular structures and their functions?**	● **Maintaining homeostasis is required by all living things.** ● **There are different types of cells that have developed ways to maintain homeostasis.** ● **Each cell has specific structures that allow it to maintain homeostasis.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
B2.3A Describe how cells function in a narrow range of physical conditions, such as temperature and pH, to perform life functions.
B2.3B Describe how the maintenance of a relatively stable internal environment is required for the continuation of life.
B2.5B Explain how the 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.
B2.3d 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 the ways that these systems interact with each other.
B2.3e Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar).
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.
B2.4i Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.
B2.5g Compare and contrast plant and animal cells.
B2.5h Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, and active transport).
B2.5i Relate cell parts/organelles to their function.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.active transport: the movement of particles against a concentration gradient which requires energy 2.cell theory: all living things are made of cells, cells are the basic unit of structure, cells come from other cells	● I can describe the difference between living and nonliving systems. ● I can describe how organisms maintain homeostasis. ● I can explain the structure and function of the

3.cell wall: a thick, rigid mesh of fibers that supports the cell located outside of the plasma membrane 4.centrioles: microtubules that serve a function during cell division (animal cells) 5.chloroplasts: organelles that conduct photosynthesis by converting light energy into chemical energy (food/glucose) 6.cilia: short, numerous projections on the outside of the cell that resemble hairs 7.cytoplasm: the semifluid material inside the plasma membrane 8.cytoskeleton: a supporting network of long, thin protein fibers (microtubules) that form a framework for the cell 9.diffusion: the net movement of particles from an area of high concentration to an area of low concentration that does not require energy 10.dynamic equilibrium: a condition in which there is continuous movement across a semi-permeable membrane but there is no overall change in conditions 11.endocytosis: the process by which a cell surrounds a substance in the outside environment, causing its enclosure in part of the plasma membrane 12.endoplasmic reticulum: membrane system of folded sacs and interconnected channels that produce proteins and lipids (smooth or rough) 13.eukaryotic: cells that contain a nucleus and membrane-bound organelles (animals, plants, fungi, protists) 14.exocytosis: the secretion of large materials at the plasma membrane using energy. 15.facilitated diffusion: uses transport proteins to move ions and other small molecules across the plasma membrane 16.flagella: long whip-like structure used for movement 17.fluid mosaic model: model of the phospholipid bilayer where molecules can float freely 18.golgi apparatus/body: organelle with flattened stack of membranes that sorts and packages proteins into sacs called vesicles 19.hypertonic solution: solution where there is less water outside the cell than solute, water moves out of the cell causing it to shrink 20.hypotonic solution: solution where there is more water outside the cell than solute, water moves into the cell causing it to swell 21.isotonic solution: condition in which the cell is at equilibrium with its solution and there is no net movement of water 22.lysosomes: vesicles that contain substances that digest excess or worn out organelles and food particles (animal cells) 23.mitochondria: organelles that conduct cellular	cell/plasma membrane. ● I can distinguish between active and passive transport. ● I can explain how substances are moved across the membrane. ● I can compare and contrast prokaryotic and eukaryotic cell. ● I can compare and contrast plant and animal cells. ● I can relate cell structures to their function.

respiration by converting food/glucose particles into usable forms of energy 24.nucleolus: organelle that makes ribosomes inside the nucleus 25.nucleus: organelle that controls the cell containing the DNA, found in eukaryotes 26.organelles: specialized structures that carry out specific cell functions 27.osmosis: diffusion of water across a semi-permeable membrane 28.passive transport: movement of substances across the cell/plasma membrane without using energy from high to low concentrations. Examples: diffusion, osmosis 29.phospholipid bilayer: two layers of phospholipids are arranged tail to tail that makes up the plasma/cell membrane 30.plasma membrane: a special boundary that helps control what enters and leaves the cell (cell membrane) 31.prokaryotic: cells that do not have a nucleus or membrane bound organelles (bacteria) 32.ribosomes: organelles responsible for the manufacture of cell proteins 33.selective permeability: a property of the plasma membrane that allows some substances to pass through while keeping others out 34.transport proteins: protein that moves substances or waste materials through the plasma membrane 35.vacuole: organelle used to store food, enzymes, wastes, and other materials needed by the cell (larger in plants) ● I know the difference between living and nonliving systems. ● I know the difference between prokaryotes and eukaryotes. ● I know the difference between plant and animal cells. ● I know how cells maintain homeostasis. ● I know the cell structures and functions.	

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 4: Cellular Energy

Essential Questions:	**Essential Understandings:**
● **How do organisms obtain and use energy?** ● **What is the energy molecule of the cell?**	● **Light energy from the sun is converted to stored energy through photosynthesis then; stored energy is used to make ATP energy for cellular activities through respiration.** ● **ATP stores chemical energy in the phosphate bonds and is released when ATP is hydrolyzed to ADP + P.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
B2.5C Describe how energy is transferred and transformed from the Sun to energy-rich molecules during photosynthesis.
B2.5D Describe how individual cells break down energy-rich molecules to provide energy for cell functions.
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.
B3.1A Describe how organisms acquire energy directly or indirectly from sunlight.
B3.1B Illustrate and describe the energy conversions that occur during photosynthesis and respiration.
B3.1C Recognize the equations for photosynthesis and respiration and identify the reactants and products for both.
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.
B3.1f Summarize the process of photosynthesis.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.adenosine triphosphate (ATP): a biological molecule that provides the basic unit of chemical energy 2.aerobic process: any metabolic process that requires oxygen 3.anaerobic process: any metabolic process that does not require oxygen	● I can summarize the laws of thermodynamics. ● I can identify the structure of ATP. ● I can explain how ATP stores and releases energy for cells. ● I can identify the cell structures used in photosynthesis. ● I can identify the reactants and products of

4.Calvin cycle: light-independent reactions where carbon dioxide is used to produce glucose 5.cellular respiration: the catabolic pathway in which organic molecules (glucose) are broken down to release ATP energy for the cell 6.chlorophyll: pigment in chloroplast that is used to trap sunlight in photosynthesis 7.chloroplast: the organelle in which photosynthesis takes place 8.electron transport chain: final step of aerobic cellular respiration where oxygen is used to create 32 ATP 9.energy: the ability to do work 10.fermentation: process that occurs after Glycolysis when NO oxygen is available, occurs in the cytoplasm to regenerate NAD+ for Glycolysis 11.glycolysis: the process of breaking down glucose to produce ATP and pyruvic acid (pyruvate) 12.grana: stacks of thylakoids 13.Krebs cycle: the breakdown of pyruvate into carbon dioxide releasing further energy 14.light dependent reaction: first step of photosynthesis where sunlight and water are used to produce oxygen 15.photosynthesis: the anabolic pathway in which light energy from the sun is converted into chemical energy (food) for the cell 16.pigments: light-absorbing molecules found in the thylakoids 17.stroma: the fluid filled space outside the grana where the Calvin Cycle/Light independent reaction of photosynthesis takes place 18.thermodynamics: energy cannot be created or destroyed, energy is converted to different forms 19.thylakoids: flattened, saclike membranes arranged in stacks where the light dependent reactions of photosynthesis takes place ● I know the laws of thermodynamics. ● I know the function of ATP in living things. ● I know the process of photosynthesis. ● I know the process of cellular respiration. ● I know how organisms use and obtain energy for cellular activities.	photosynthesis. ● I can describe the steps of photosynthesis. ● I can identify the cell structures used in cellular respiration. ● I can identify the reactants and products of cellular respiration. ● I can describe the steps of cellular respiration. ● I can compare and contrast photosynthesis and cellular respiration. ● I can explain importance of oxygen in cellular respiration. ● I can summarize lactic acid and alcoholic fermentation. ● I can write the chemical reactions for photosynthesis and cellular respiration. ● I can identify organisms that use photosynthesis and cellular respiration. ● I can provide examples of cellular activities requiring energy.

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 5: Cell Reproduction

Essential Questions:	**Essential Understandings:**
● **Why are cells small?** ● **How do living things reproduce to maintain the continuity of life?** ● **Why is cell division important?**	● **Cells must stay small in order to maintain homeostasis and communicate efficiently.** ● **Living things utilize asexual and/or sexual reproduction to generate new cells.** ● **Cell division is important to organism growth, repair and heredity.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

B2.1C Explain cell division, growth, and development as a consequence of an increase in cell number, cell size, and/or cell products.

B2.1d Describe how, through cell division, cells can become specialized for specific function.

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.

B4.3B Explain why only mutations occurring in gametes (sex cells) can be passed on to offspring.

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.

B4.3e Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.

B4.3f Predict how mutations may be transferred to progeny.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.anaphase: 3rd stage of mitosis, sister chromatids are pulled apart and microtubules move the chromosomes to opposite poles of the cell. 2.apoptosis: Programmed cell death. 3.cancer: Uncontrolled growth and division of cells that can be caused by changes in control of the cell cycle and also may be caused by environmental factors. 4.carcinogens: Anything known to cause cancer 5.cell cycle: The process of cellular reproduction, occurring in 3 main stages—interphase (growth), mitosis (nuclear division) & cytokinesis (cytoplasm division).	● I can explain why cells are small. ● I can identify what limits cell size. ● I can recognize and diagram the stages of the cell cycle (Interphase, Mitosis, Cytokinesis). ● I can identify the structures involved in the cell cycle. ● I can explain how the cell divides using Mitosis. ● I can differentiate between plant and animal cell cytokinesis. ● I can describe the results of mitosis and the cell cycle.

6.centromere: Cell structure that joins two sister chromatids. 7.chromatin: Relaxed (string) form of DNA in the nucleus of a cell. 8.chromosome: DNA containing structure that carries genetic material from one generation to another. 9.crossing over: Exchange of chromosomal segments between a pair of homologous chromosomes during prophase I of meiosis. 10.cyclin & CDK: Proteins and enzymes that control the cell cycle 11.cytokinesis: 3rd main stage of the cell cycle, during which the cell's cytoplasm divides, creating a new cell. 12.diploid: Cells with 2 copies of each chromosome (2n). (skin cells, muscle cells, body cells, etc) 13.fertilization: Process by which haploid gametes combine, forming a diploid cell with 2n chromosomes, with one set (n) of chromosomes from each parent 14.gamete: A haploid sex cell, formed during meiosis, that can combine with another haploid sex cell and produce a diploid fertilized egg. 15.gene: Functional unit of DNA that controls inherited trait expression that is passed on from one generation to another. 16.haploid: Cell with half the number of chromosomes (n) (gametes, egg, sperm, etc) 17.homologous chromosome: One of 2 paired chromosomes (1 from ea. parent) that carries genes for a specific trait at the same location. 18.interphase: 1st stage of the cell cycle, during which a cell grows, matures and replicates its DNA. 19.meiosis: Reduction division process, occurring only in reproductive cells, in which 1 diploid (2n) cell produces 4 haploid (n) cells that are not genetically identical. 20.meiosis I: Pairing up, lining up, and separating of homologous chromosomes in four stages (prophase I, metaphase I, anaphase I, telophase I) 21.meiosis II: Occurs after meiosis I, separating sister chromatids (identical to mitosis) in four stages (prophase II, metaphase II, anaphase II, telophase II) 22.metaphase: 2nd phase of mitosis in which motor proteins pull sister chromatids to the cell's equator. 23.mitosis: 2nd main stage of the cell cycle during which the cell's replicated DNA divides and 2 genetically identical diploid daughter cells are produced. 24.prophase: 1st stage of mitosis, during which the cell's chromatin condenses into chromosomes. 25.sister chromatid: Structure that contains identical DNA copies and is formed during DNA replication. 26.spindle apparatus: Structure made of spindle fibers, centrioles and aster fibers that is involved in moving	● I can identify the number of chromosomes in daughter cells as a result of mitosis. ● I can explain how the cell cycle is regulated. ● I can describe cancer and how it relates to the cell cycle. ● I can explain apoptosis. ● I can summarize stem cells and their importance. ● I recognize and summarize the stages of meiosis and the structures involved. ● I can explain how meiosis provides genetic variation. ● I can describe the results of meiosis and the chromosome number in each new cell. ● I can recognize and summarize the stages of meiosis. ● I can summarize the results of meiosis. ● I can compare and contrast mitosis and meiosis. ● I can explain why cell division is important.

and organizing chromosomes before the cell divides. 27.stem cell: Unspecialized cell that can develop into a specialized cell under the right conditions 28.telophase: Last stage of mitosis where nucleoli reappear. New nuclear membranes begin to form, but the cell has not yet completely divided. ● I know why cells are small. ● I know the difference between asexual and sexual reproduction. ● I know mitosis and meiosis relate to the production of new cells and to passing on genetic information between generations. ● I know how mutations may be transferred to offspring. ● I know genetic recombination creates a variety of traits.	

Phase III Textbook/Materials

Phase IV Summative Assessment Evidence	
Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 6: DNA and Protein Synthesis

Essential Questions:	**Essential Understanding:**
● **What is the structure and function of DNA and RNA?** ● **How is DNA used to make proteins?** ● **What are mutations?**	● **Nucleotides make up DNA and RNA which store and communicate genetic information through protein synthesis.** ● **Genes are segments of DNA that contain the inheritable information that control cellular activities, build structures, and make molecules through protein synthesis.** ● **Mutations are changes in DNA that can affect protein synthesis.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

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.

B4.2C Describe the structure and function of DNA.

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).

B4.2E Propose possible effects (on the genes) of exposing an organism to radiation and toxic chemicals.

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.

B4.2g Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Anti-codon: Set of 3 nitrogen bases/nucleotides found on the tRNA that base pairs with the mRNA codon. 2.Chromosomal Mutations: Mutation that occurs at the chromosome level resulting in changes in the gene distribution to gametes during meiosis; caused when parts of chromosomes break off or rejoin incorrectly 3.Codon: A set of three nucleotides and the nitrogen bases. There are both RNA and DNA codons. 4.DNA Replication: The process in which DNA is copied, occurs during Interphase	● I can diagram and label the structural components of DNA. ● I can differentiate between DNA and RNA. ● I can explain how DNA replicates. ● I can summarize the importance of DNA replication. ● I can identify the base pairing rules for DNA. ● I can describe the structure and function of the three types of RNA molecules. ● I can describe a codon and anti-codon. ● I can transcribe DNA into mRNA.

5.Double Helix: The shape of DNA composed of two strands twisted together, discovered by Watson & Crick 6.Frameshift Mutation: A mutation in which a single nitrogen base is added to or deleted from the DNA codon 7.Messenger RNA: A type of RNA that gets instructions from DNA in the nucleus and takes the message to the cytoplasm 8.Mutagen: any agent (physical or environmental) that can cause a mutation or can increase the rate of mutation 9.Mutation: change in a DNA sequence 10.Nitrogenous base: Adenine, Thymine, Cytosine, or Guanine found in a DNA nucleotide, A, C, G, and Uracil found in an RNA nucleotide 11.Nucleotide: The subunit for both DNA and RNA. Consists of 3 parts: phosphate, sugar, and nitrogen base. 12.Point Mutation: A change in a single nitrogen base pair in a DNA codon 13.Ribosomal RNA: A type of RNA that provides the site of protein synthesis 14.Transcription: A process where the DNA sequence/gene is copied into mRNA, occurs in the nucleus 15.Transfer RNA: A type of RNA that delivers amino acids to the ribosome to be assembled into protein. 16.Translation: The process of converting the messenger RNA into a sequence of amino acids to make a protein ● I know the structure and function of DNA and RNA. ● I know how DNA is replicated. ● I know how DNA is transcribed and translated to proteins. ● I know how mutations affect protein synthesis.	● I can identify the base pairing rules for DNA to mRNA and mRNA to tRNA anti-codons. ● I can translate mRNA to amino acid sequence. ● I can summarize protein synthesis. ● I can identify where transcription and translation take place in the cell. ● I can identify causes of mutations. ● I can analyze how mutations can affect protein synthesis. ● I can summarize how mutations affect gene expression.

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum
Unit 7: Heredity and Mendelian Genetics

Essential Questions:	**Essential Understanding:**
● **How are traits inherited?** ● **How are genes expressed?**	● **Traits are inherited from parent organisms.** ● **Each organism contains thousands of genes on each DNA strand - some traits are controlled by one, others by two or more.** ● **The genes independently segregate and assort during cell division to make gametes, which allow for genetic diversity.** ● **At fertilization, those gene combinations will determine the structure and functions of the organism.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
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.
B4.1c Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.
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.
B4.3d 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.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Allele: different form of a gene for a trait (exp. blue, brown, green eyes gene) 2.Cross-pollination: Transferring a male gamete from a flower to the female reproductive organ in a flower of another	● I can summarize how genes are passed from parent to offspring. ● I can identify and draw homozygous and heterozygous genotypes on homologous chromosomes. ● I can distinguish between dominant and

3.Dihybrid Cross: The phenotypic ratio result in a 9:3:3:1 for two heterozygous parents for both traits.
4.Dominant: Genes that mask the recessive, use a capital letter to show the gene (T).
5.F1 generation: The offspring(Result) of the parent generation; parents that are purebreds will have all heterozygous offspring.
6.F2 generation: The offspring(Result) of F1 generation(heterozygous) will result in a 3:1 ratio of dominant to recessive.
7.Genetics: Science of heredity
8.Genotype: An organism's allele/gene pairs
9.Gregor Mendel: Father of genetics
10.Heredity: Passing of traits to the next generation
11.Heterozygous: Organism with 2 different alleles/genes for a trait (exp. Tt)
12.Homozygous: Organisms with two of the same alleles/genes for a trait (exp. TT, tt)
13.Hybrids: Heterozygous organisms
14.Law of Independent Assortment: Alleles/Genes for different traits separate independently from each other. Mendel saw that pea texture and pea color are separate.
15.Law of Segregation: Random distribution of alleles/genes occurs during gamete formation (meiosis)
16.Monohybrid: A cross showing a single trait.
17.Parent generation: Purebred X Purebred; Result is hybrid
18.Phenotype: Observable characteristic that is showed as a result of an allele's pair (genotype)
19.Punnett Square: A graphic organizer that predicts possible genotypes of offspring.
20.Recessive: Genes that are masked by a dominant gene. Shown in homozygous organisms. Written with lowercase letters (tt)
21.Self-fertilization: When a female gamete is fertilized with a male gamete within the same flower.

- I know how traits are passed from parents to offspring.
- I know how genotypes determine phenotypes.
- I know Mendel's Laws of Dominance, Segregation, and Independent Assortment.
- I know how dominant and recessive genes are expressed.

recessive genes.

- I can differentiate between genotypes and phenotypes.
- I can differentiate between traits, genes, and alleles.
- I can conduct monohybrid crosses.
- I can use and interpret punnett squares.
- I can write genotypes.
- I can identify genotypes and phenotypes.
- I can summarize the results of Mendel's single trait crosses.
- I can summarize Mendel's law of dominance.
- I can summarize the Law of Segregation.
- I can perform a dihybrid cross.
- I can analyze the phenotypic ratios of genetic crosses.
- I can summarize the Law of Independent Assortment.
- I can explain gene linkage.
- I can explain polyploidy.

Phase III Textbook/Materials

Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum
Unit 8: Complex Inheritance and Human Genetics

Essential Questions:	**Essential Understanding:**
● **What are human genetic disorders?** ● **What are the complex patterns of inheritance?** ● **How are chromosomal genetic disorders identified?**	● **Huntington's, Androchondroplasia, Hemophilia, Albinism, Tay Sachs, PKU, Cystic Fibrosis are genetic disorders that affect humans.** ● **Some traits are expressed through complex inheritance patterns, sex-linked, multiple alleles, codominance, incomplete dominance, epistasis, and polygenic.** ● **Nondisjunction in meiosis results in extra or missing chromosome that can be identified by a karyotype.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
B4.1c Differentiate between dominant, recessive, codominant, polygenic, and sex-linked traits.
B4.3C Explain how it might be possible to identify genetic defects from just a karyotype of a few cells.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Autosome: Pairs of matching homologous chromosomes in somatic cells. (First 22 pairs in humans) 2.Carrier: An individual heterozygous for a specific trait. 3.Co-dominance: Pattern where phenotypes of both homozygous parents are produced in heterozygous offspring so that both alleles are equally expressed. (AB Blood type, Sickle Cell Anemia) 4.Epistasis: The expression of a one gene depends on the presence or absence of another. 5.Incomplete Dominance: Inheritance pattern where the phenotype of a heterozygote is intermediate between those of the two homozygotes; neither allele of the pair is dominant but combine and display a new trait. (Pink Snap Dragon flower color) 6.Karyotype: Graphic representation of chromosome	● I can identify dominant and recessive human genetic disorders. ● I can create a pedigree. ● I can analyze pedigree. ● I can perform crosses with sex-linked traits. ● I can perform crosses with incomplete and codominance inheritance. ● I can perform crosses with multiple alleles inheritance. ● I can predict outcomes of genetic crosses with complex inheritance. ● I can identify examples of nondisjunction. ● I can gender and chromosome number from a karyotype. ● I can identify specific examples of complex inheritance patterns. ● I can describe how the environment can

pairs, can be used to determine chromosomal abnormalities. 7.Multiple Allele: Presence of more that two alleles for a genetic trait. (ABO Blood Type, rabbit fur color) 8.Non-disjunction: Results from homologous chromosomes failing to separate during meiosis creating gametes with extra or missing chromosomes. (Downs Syndrome, Turners) 9.Pedigree: Graphic representation of genetic inheritance used by geneticists to map genetic traits. 10.Polygenic Inheritance: Inheritance pattern of a trait controlled by two or more genes; genes may be on the same or different chromosomes. 11.Polygenic Trait: Traits that are controlled by multiple gene pairs. (Height) 12.Sex Chromosome: in humans, the 23rd pair of chromosomes; determine the sex of an individual and carry sex-linked characteristics. 13.Sex-linked Trait: Traits controlled by genes located on sex chromosomes. (Hemophilia, Red-Green Color Blindness, Eye Color in Fruit Flies) ● I know the complex patterns of inheritance. ● I know how nondisjunction occurs. ● I know how genotypes and phenotypes are determined in complex patterns of inheritance. ● I know how to create a pedigree. ● I know how to a karyotype.	influence phenotype expression.

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum
Unit 9: Biotechnology and Genetic Engineering

Essential Questions:	**Essential Understanding:**
● **What is biotechnology genetic engineering?** ● **What is genetic engineering?** ● **How do we understand the function of genes?**	● **Genomics is the study of how our DNA works.** ● **By understanding the processes of replication, transcription, and translation, we may improve our lives by manipulating DNA for the betterment of mankind.** ● **Genetic engineering allows us the opportunity to create pest resistant crops, cure disease, develop medicines, and extend lives while improving quality of life.** ● **With this great power there comes great responsibility as we pursue this field.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
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.
B4.2g Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.
B4.2h Recognize that genetic engineering techniques provide great potential and responsibilities
B4.r2i Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes.
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.
B4.r5a Explain how recombinant DNA technology allows scientists to analyze the structure and function of genes.
B4.r5b Evaluate the advantages and disadvantages of human manipulation of DNA.
B5.3f Demonstrate and explain how biotechnology can improve a population and species.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.cloning: process where the DNA from an organism is used to create a genetic copy of that organism (Dolly) 2.DNA fingerprinting: separating an individual's unique sequence of DNA fragments to observe distinct banding patterns; can be used by forensic scientists to identify suspects and determine paternity	● I can identify examples of selective breeding. ● I can explain how genes are inserted into a plasmid. ● I can explain the steps in PCR. ● I can explain how recombinant DNA works. ● I can interpret a DNA fingerprint - both for paternity and criminal investigation.

3.DNA ligase: enzyme that puts together (glues) DNA fragments together 4.DNA microarray: silicon chips or microscope slides with DNA fragments that can allow many genes in a genome to be studied simultaneously 5.gel electrophoresis: process that involves using electric current to separate DNA fragments by size 6.gene therapy: technique to correct mutated disease-causing genes 7.genetic engineering: technology used to manipulate an organism's DNA by inserting DNA of another organism 8.genome: total DNA in each cell nucleus of an organism 9.genomics: study of an organism's genome 10.plasmid: any of the small, circular, double-stranded DNA molecules that can be used as a vector (usually from bacteria) 11.polymerase chain reaction (PCR): genetic engineering technique that can make copies of specific regions of a DNA fragment 12.recombinant DNA: newly generated DNA fragment containing foreign DNA 13.restriction enzyme: enzyme that cuts DNA into fragments at a specific sequence 14.selective breeding: breeding for desired traits 15.transformation: process in which bacterial cells take up recombinant plasmid DNA 16.transgenic organism: organism that is genetically engineered by inserting a gene from another organism (aka GMOs) ● I know how to create recombinant DNA. ● I know how GMOs are made. ● I know the advantages and disadvantages of genetic engineering. ● I know how to interpret a DNA fingerprint.	● I can identify several uses for genetic engineering. ● I can compare the pros and cons for cloning. ● I can debate the advantages and disadvantages of manipulating DNA. ● I can give examples of GMOs. ● I can identify several uses for gene therapy. ● I can discuss how genomic has helped us understand how genes work.

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum
Unit 10: History of LIfe and Theory of Evolution

Essential Questions:	**Essential Understanding:**
● **What is the history of life?** ● **How do organisms evolve?** ● **What is natural selection?** ● **What are pieces of evidence for evolution?**	● **The geological time scale identify major events of life of earth.** ● **Mutations provide the basis for evolution.** ● **Natural selection shows that certain alleles are more beneficial for survival allowing those alleles to be passed to offspring, changing the allele frequency which shows evolution.** ● **Fossil record, comparative anatomy, natural selection, mutations, and adaptations provide evidence for evolution.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
B2.4g Explain that some structures in the modern eukaryotic cell developed from early prokaryotes, such as mitochondria, and in plants, chloroplasts.
B5.1A Summarize the major concepts of natural selection (differential survival and reproduction of chance inherited variants, depending on environmental conditions).
B5.1B Describe how natural selection provides a mechanism for 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).
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).
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.
B5.2a Describe species as reproductively distinct groups of organisms that can be classified based on morphological, behavioral, and molecular similarities.
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.
B5.r2d Interpret a cladogram or phylogenetic tree showing evolutionary relationships among organisms.
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.
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.
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 new species.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Adaptive radiation: process by which a single species or small group of species evolves into several different forms that live in different ways; rapid growth in the diversity of a group of organisms 2.Allelic frequency: percentage of any specific allele in a population's gene pool (used in Hardy-Weinberg principle) 3.Allopatric Speciation: occurs when a population divided by a geographic barrier evolves into two or more populations unable to interbreed 4.Analogous structure: structure that has the same function but different construction and was NOT inherited by a common ancestor ex: bird wing and fly wing 5.Ancestral Trait: more primitive characteristic that appeared in common ancestors 6.Artificial Selection: Humans select organisms for certain traits in order to produce offspring having those traits (Darwin's term for selective breeding) 7.Biogenesis: states that only living organisms can produce other living organisms 8.Bottleneck: process in which a large population declines in number then rebounds 9.Camouflage: structural adaptation that enables species to blend with their surroundings; allows a species to avoid detection by predators 10.Convergent evolution: process by which unrelated organisms independently evolve similarities when adapting to similar environments 11.Derived Trait: new feature that has not appeared in common ancestors 12.Directional selection: form of natural selection where a shift of a population toward an extreme version of a beneficial trait 13.Disruptive selection: form of natural selection in which individuals with average traits are removed, creating two populations with extreme forms of the traits	● I can identify major events in the four major eras of the geologic time scale. ● I can summarize relationships between present and past organisms on Earth. ● I can differentiate between radiometric and relative dating methods. ● I can identify various scientists contributions to the history of life. ● I can differentiate between biogenesis and spontaneous generation. ● I can summarize the four principles of natural selection. ● I can provide examples of natural selection. ● I can identify the three types of natural selection. ● I can identify examples of evolution. ● I can compare DNA of organisms to show common ancestry. ● I can interpret a cladogram and phylogenic tree. ● I can identify adaptations. ● I can explain how natural selection leads to organisms that are well suited for the environment. ● I can describe how changes in allele frequency promotes evolution. ● I can describe speciation.

14.Divergent evolution: when two or more species sharing a common ancestor become more different over time 15.Endosymbiont Theory: explains that eukaryotic cells may have evolved from prokaryotic cells 16.Evolution: inheritable changes in groups of living organisms over time 17.Fitness: measure of a trait's relative contribution to the following generation (success of a trait to help the organism survive) 18.Fossil: the remains (or an impression) of a plant or animal that existed in a past geological age and that has been excavated from the soil 19.Founder Effect: random effect that can occur when a small population settles in an area separated from the rest of the population and interbreeds 20.Gene pool: consists of all genes, including all the different alleles, that are present in a population 21.Genetic drift: random change in allelic frequencies in a population 22.Geographic isolation: form of reproductive isolation in which two populations are separated physically by geographic barriers such as rivers, mountains, or stretches of water 23.Geologic Time Scale: model showing major geological and biological events in earth's history 24.Gradualism: theory that evolution occurs in small gradual steps over time 25.Hardy-Weinberg Principle: states that allelic frequencies in populations stay the same unless they are affected by a factor that causes change 26.Homologous structure: anatomically similar structure inherited from a common ancestor example:human arm and whale fin 27.Mimicry: morphological adaptation in which one species evolves to resemble another species for protection or other advantages; may provide protection from predators or other advantages 28.Natural Selection: theory of evolution developed by Darwin based on four ideas: excess reproduction, variations, inheritance, and the advantages of certain trait in an environment (survival of the fittest) 29.Protocell: a large, ordered structure, enclosed by a membrane, that carries out some life activities, such as growth and division 30.Punctuated equilibrium: a theory of evolution holding that evolutionary change in the fossil record came in fits and starts rather than in a steady process of slow change 31.Reproductive isolation: separation of species or populations so that they cannot interbreed and produce fertile offspring 32.Sexual Selection: change in the frequency of a trait	

based on competition for a mate 33.Speciation: the formation of new species as a result of evolution 34.Spontaneous Generation: idea that life arises from nonliving things 35.Stabilizing selection: form of natural selection in which organisms with extreme expressions of a trait are removed, average form of trait is favored 36.Sympatric Speciation: occurs when a species evolves into a new species in an area without a geographic barrier 37.Vestigial structure: reduced form of a functional structure that indicates shared ancestry, but has no clear function in the modern species ● I know the events of the Geologic time scale. ● I know scientists contributions to the history of life. ● I know that natural selection is the mechanism for the theory of evolution. ● I know the principles of natural selection. ● I know how organisms evolve. ● I know how speciation can occur. ● I know how adaptations assist in survival.	

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 11: Classification of Living Things

Essential Questions:	**Essential Understanding:**
● **How are living things organized into classification groups?** ● **How are living things organized to maintain homeostasis?**	● **Living things are classified into a system that is based on their complexity (single celled to multicelled), composition (body structure/types of cells/etc.), matter of obtaining energy (autotroph/heterotroph), and methods of reproduction (asexual/sexual).** ● **Organisms use many strategies to maintain homeostasis from the cellular level to the organ system level**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

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.

B2.3e Describe how human body systems maintain relatively constant internal conditions (temperature, acidity, and blood sugar).

B2.3f Explain how human organ systems help maintain human 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, enzyme and substrate to interlocking puzzle pieces).

B2.4A Explain that living things can be classified based on structural, embryological, and molecular (relatedness of DNA sequence) evidence.

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).

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.

B2.4h Describe the structures of viruses and bacteria.

B2.4i Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Alternation of generation: reproductive life cycle alternating from haploid to diploid forms 2.Archaeabacteria: single celled, prokaryotic;	● I can identify all the human body systems and their functions. ● I can identify major organs of all of the human

evolutionarily closer to eukaryotes 3.Aristotle: First to group organisms as plant or animal but did not show evolutionary relatives 4.Autotrophs: Organism that make their own food (producer) 5.Bacteria (Eubacteria): single-celled organisms that are prokaryotic; most ancient organisms known 6.Binary Fission: asexual form of reproduction 7.Binomial nomenclature: 2-word naming system for Scientific name using genus and species 8.Carolus Linnaeus: Father of Taxonomy; known for binomial nomenclature 9.Cellulose: substance found in plants and some protists cell walls 10.Chitin: substance found in fungi cell walls 11.Circulatory System: heart, lungs, arteries, blood, capillaries, veins that transport nutrients and oxygen 12.Class: taxon made up of orders 13.Decomposer: a type of heterotroph that breaks down dead and decaying organisms for energy 14.Digestive System: Mouth (teeth), esophagus, stomach, liver, pancreas, intestines that breaks down food for energy and absorbs nutrients 15.Domain: First group of taxonomy; largest number of organisms; based on very broad characteristics; there are 3 16.Endocrine System: Many glands that regulate many body functions using chemical signals 17.Eukarya Domain: Eukaryotic; single & multi-cellular; includes protists, plants, fungi, and animals 18.Eukaryotes: Cells that contain a nucleus and membrane bound organelles 19.Excretory System: Kidneys, bladder, lungs, skin that remove wastes 20.Family: taxon made of genera; names end in -dae 21.Genus: taxon made up of species; first part of Scientific name 22.Heterotrophs: Organisms that cannot make their own food and must feed on other organisms (consumer) 23.Immune System: Blood, lymphocytes, b-cells, t-cells, memory cells that fight disease 24.Integumentary System: Skin, hair, nails that protect body from invaders, control body temperature, maintain tissue moisture 25.Invertebrate: Animals that do not have a backbone 26.Kingdom: 2nd largest taxonomical group; there are 6 Kingdoms 27.Kingdom Animalia: Eukaryotes, heterotrophs and are multicellular 28.Kingdom Fungi: Eukaryotes; cell wall made of chitin; heterotrophic decomposers; can be parasites or saprobes	body systems. ● I can describe the specific functions of organs within each organ system. ● I can describe how several of the systems interact to maintain homeostasis ● I can identify many different adaptations that accomplish the same functions (ex. lungs vs. gills) ● I can name the 3 domains and 6 kingdoms. ● I can describe the general characteristics of each kingdom. ● I can name the domain, kingdom, phylum, class, order, genus and species of humans and several other organisms. ● I can determine common ancestry. ● I can use binomial nomenclature to describe several organisms and how related they are. ● I can explain why viruses are not alive. ● I can compare and contrast viruses and bacteria.

29.Kingdom Plantae: Eukaryotes; autotrophs, cell wall made of cellulose; mulitcellular 30.Kingdom Protista: Most diverse organisms of all the kingdoms, Eukaryotes; can be autotrophs or heterotrophs, some have cells walls, mostly unicellular 31.Multicellular: organism made up of 2 or more cells 32.Muscular System: Muscles, tendons that move body, pump heart, move substances for digestion 33.Nervous System: Spinal cord, brain, neurons, skin, eyes, ears, tongue, and nose that controls body activities and reacts to stimuli 34.Order: taxon made up of families 35.Photosynthesis: Process of converting radiant energy of the sun to chemical energy stored in the bonds of glucose; occurs in chloroplast 36.Phylum: taxon made up of classes (aka Division for Plant and Fungus) 37.Protozoan: animal like protists 38.Respiratory System: Nose, mouth, lungs, pharynx, trachea, diaphragm, bronchi that take in oxygen and remove carbon dioxide 39.Skeletal System: Bones, ligaments that support body, protect vital organs, movement, store Ca+, etc 40.Species: least number of organisms present; most specific taxon; second part of Scientific name 41.Spore: a type of reproductive cell that can form a new organism 42.Taxon: Group of organisms with similar traits 43.Taxonomy: Science of naming organisms and assigning them to groups 44.Unicellular: organism made up of only 1 cell 45.Vascular Tissues: plant structure consisting of xylem and phloem that transports water and nutrients throughout the plant 46.Vertebrate: Animals that have a backbone ● I know the structure and functions of the human body systems. ● I know how each of the systems maintain homeostasis. ● I know how organisms are classified. ● I know different adaptations that accomplish the same tasks for different organisms. ● I know viruses are not alive. ● I know how viruses are the same as and different from bacteria.	

Phase III Textbook/Materials

Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 12: Ecosystem Interactions

Essential Questions:	**Essential Understanding:**
● **What is ecology?** ● **How do living organisms acquire and store energy?** ● **How is matter and energy transferred through an ecosystem?**	● **Ecology is the study of the interactions between organisms and their environment.** ● **Living organisms acquire energy either directly or indirectly from sunlight to store energy in chemical bonds.** ● **Matter and energy flow through an ecosystem at each trophic level of a food web.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology
B3.1A Describe how organisms acquire energy directly or indirectly from sunlight.
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.
B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.
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.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.Abiotic Factor: physical, or nonliving, factor in an ecosystem 2.Autotroph: an organism that can make their own food (plant) 3.Biological Community: The populations of plants animals and microorganisms living and interacting in a certain area at a given time. 4.Biomass: the total mass of living matter in a given unit area 5.Biosphere: the regions of the surface and atmosphere of the Earth (or other planet) where living organisms exist	● I can identify examples of biotic and abiotic factors in an ecosystem ● I can analyze how biotic and abiotic factors affect different species. ● I can distinguish between habitat and niche. ● I can describe the trophic levels. ● I can diagram the flow of energy through an ecosystem. ● I can identify the sun as the ultimate source of energy. ● I can identify the ecological levels of organization.

6.Biotic Factor: a living factor within an ecosystem 7.Carnivore: a heterotroph that eats animals for nutrition 8.Commensalism: the relation between two different kinds of organisms when one receives benefits from the other without damaging it (+/O) 9.Decomposers: organisms that break down wastes and dead organisms and return raw materials to the environment 10.Ecology: the branch of biology concerned with the relations between organisms and their environment 11.Ecosystem: a system formed by the interaction of a community of organisms with their physical environment 12.Food Chain: a community of organisms where each member is eaten in turn by another member showing the flow of energy 13.Food Web: a combination of all the food chains in a community 14.Habitat: the type of environment in which an organism or group normally lives or occurs 15.Herbivore: a heterotroph that eats autotrophs for nutrition 16.Heterotroph: an organism that consumes for nutrition 17.Mutualism: the relation between two different species of organisms that are interdependent (+/+) 18.Niche: the status/role of an organism within its environment and community 19.Omnivore: a heterotroph that can eat both autotrophs and animals for nutrition 20.Parasitism: the relation between two different kinds of organisms in which one receives benefits from the other by causing damage to it (+/-) 21.Population: organisms of the same species that can interbreed 22.Scavenger: a heterotroph that eats dead organisms for nutrition 23.Symbiosis: the relation between two different species of organisms that are interdependent 24.Trophic Level: each step in a food chain or food web ● I know examples of biotic and abiotic factors in an ecosystem. ● I know trophic levels in which living organisms meet their energy requirements. ● I know the sun is the ultimate source of energy for living organisms. ● I know energy is stored in the chemical bonds of organic molecules that make up living organisms. ● I know the different types of symbiotic relationships that exist between living	● I can explain how energy is stored in chemical bonds of living organisms. ● I can differentiate between symbiotic relationships. ● I can compare and contrast a food chain and food web. ● I can construct a food chain and food web. ● I can describe food chains, food webs, and pyramid models. ● I can compare and describe cycles of matter. ● I can recognize and identify the stages of primary and secondary ecological succession. ● I can differentiate among the biomes.

organisms. ● I know the levels of ecological organization. ● I know the similarities and differences between a food chain and food web. ● I know that as matter and energy flow through an ecosystem. ● I know ecological succession results in changes to an ecosystem. ● I know characteristics of biomes.	

Phase III Textbook/Materials
Phase IV Summative Assessment Evidence

Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan

Phase II Curriculum

Unit 13: Population Ecology

Essential Questions:	**Essential Understanding:**
● **What are the characteristics of population growth?** ● **What threatens to biodiversity?**	● **Population size changes due to biotic and abiotic factors in the environment.** ● **Populations grow exponentially until they reach the environment's carrying capacity.** ● **Biodiversity is threatened by overexploitation, loss of habitat, habitat fragmentation, & eutrophication.**

Curriculum Standards- DOK noted where applicable with Standards

Michigan HSCE for Biology

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.

B3.4B 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.

B3.4d Describe the greenhouse effect and list possible causes.

B3.4e List the possible causes and consequences of global warming.

B3.5A Graph changes in population growth, given a data table.

B3.5B Explain the influences that affect population growth.

B3.5C Predict the consequences of an invading organism on the survival of other organisms.

B3.5d Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.

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.

LEARNING TARGETS

Knowledge/Content **I Know …**	**Skills/Processes** **I Can …**
Vocab: 1.acid precipitation: SO2 is released when fossil fuels are burned. Releases NO¬2 into the atmosphere. React with water + other substances → Sulfuric + nitric acid. Removes calcium, potassium, and other nutrients from the soil, depriving the plant of these nutrients,	● I can describe characteristics of populations. ● I can identify and give examples of abiotic and biotic limiting factors. ● I can differentiate between density- dependent and density- independent factors.

damaging the plant's tissues, and slowing their growth. 2.age structure: The number of males and females in each of the three age groups: pre-reproductive stage, reproductive stage, and post-reproductive stage. (<20, 20-44, >44) 3.biodiversity: The variety of life in an area that is determined by the number of different species in that area. Increases the stability of an ecosystem and contributes to the health of the biosphere. 3 types: genetic, species, ecosystem. 4.biological augmentation: Adding natural predators to a degraded ecosystem to deal with pests. 5.biological magnification: The increasing concentration of toxic substances in organisms as trophic levels increase in a food chain/web. 6.bioremediation: The use of living organisms, such as prokaryotes, fungi, or plants, to detoxify a polluted area. 7.carrying capacity: The maximum number of individuals in a species that an environment can support for the long term. Limited by the energy, water, oxygen, and nutrients available. 8.demography: The study of human population size, density, distribution, movement, and birth and death rates. 9.density-dependent factor: Limiting factor. Any factor in the environment that depends on the number of members in a population per unit area. Biotic factors. Such as predation, disease, parasites, and competition. 10.density-independent factor: Limiting factor. Any factor that does not depend on the number of members in a population per unit area. Abiotic factors including natural phenomena. 11.ecosystem diversity: The variety of ecosystems that are present in the biosphere. 12.edge effect: Different environmental conditions that occur along the boundaries of an ecosystem. 13.Emigration: The number of individuals moving away from a population. 14.eutrophication: A form of water pollution. Destroys underwater habitats for fish and other species. Occurs when fertilizers, animal waste, sewage, and other substances rich in nitrogen and phosphorus flow into waterways, causing extensive algae growth → use oxygen supply during rapid growth + during decaying process post-mortem. Other organisms suffocate. 15.extinction: When the last member of the species dies. 16.genetic diversity: The variety of genes or inheritable characteristics that are present in a population. Includes immunities, ability to obtain nutrients, recovery, etc. 17.habitat destruction: Clearing of entire habitats. Many species go extinct due to habitat loss.	● I can analyze population growth curves. ● I can determine range of tolerance on a graph. ● I can differentiate between exponential growth and logistic growth. ● I can describe carrying capacity of a population. ● I can graph changes in population growth given a data table. ● I can predict the consequences of exotic/invasive species. ● I can describe“R” Strategist and “K” Strategist. ● I can describe factors of ecosystem stability. ● I can summarize the negative impact of humans on the environment..

18.habitat disruption: Chain of events resulting in population decline for various species.
19.habitat fragmentation: The separation of an ecosystem into small pieces of land.
20.Immigration: The number of individuals moving into a population.
21.keystone species: A species that plays a large role in the ecosystem. Decline can affect an entire ecosystem.
22.mass extinction: A large percentage of all living species become extinct in a relatively short period of time.
23.natural resources: All materials and organisms found in the biosphere, including minerals, fossil fuels, nuclear fuels, plants, animals, soil, clean water, clean air, and solar energy.
24.nonrenewable resources: The resources that are found on Earth in limited amounts or those replaced by natural processes over extremely long periods of time. Include fossil fuels and mineral deposits.
25.overexploitation: Excessive use of species that have economic value.
26.population density: A characteristic of population. The number of organisms per unit area.
27.population growth rate: Explains how fast a given population grows.
28.renewable resources: Resources that are replaced by natural processes much faster than they are consumed. Includes solar energy, wind energy, geothermal energy, hydroelectric energy.
29.spatial distribution: Dispersion. A characteristic of population. The pattern of spacing of a population within an area. Three types: uniform, clumped, random.
30.species diversity: The number of different species and the relative abundance of each species in a biological community.
31.sustainable use: Using resources at a rate in which they can be replaced or recycled while preserving the long-term environmental health of the biosphere. Reducing the amount of resources consumed, recycling resources, preserving ecosystems, using resources responsibly.
32.zero population growth: Births + Immigration = Deaths + Emigration

I Know…

- I know the characteristics of populations.
- I know how populations grow.
- I know threats to biodiversity.

Phase III Textbook/Materials

Phase IV Summative Assessment Evidence	
Common Summative Unit Assessments: (*identifies Performance Task)	**Agreed Upon Interim Summative Assessments:** (*identifies Performance Task)

Phase V Learning Plan