

	Biology https://www.doe.mass.edu/frameworks/scitech/2016-04.pdf Biology Syllabus Binder Notebook
	Unit ONE: Evolution and Biodiversity
Essential Questions	What does it mean to be alive? How does a virus compare to a living thing? What do all living things have in common? How is life organized? What does evolutionary theory suggest about the unity and diversity of life? What evidence exists to support the theory of evolution? How do new species evolve?
Science Standards	HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence, including molecular, anatomical, and developmental similarities inherited from a common ancestor (homologies), seen through fossils and laboratory and field observations. HS-LS4-2. Construct an explanation based on evidence that Darwin's theory of evolution by natural selection occurs in a population when the following conditions are met: (a) more offspring are produced than can be supported by the environment, (b) there is heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others. HS-LS4-4. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environments. HS-LS4-5. Evaluate models that demonstrate how changes in an environment may result in the evolution of a population of a given species, the emergence of new species over generations, or the extinction of other species due to the processes of genetic drift, gene flow, mutation, and natural selection.

Concepts and skills	• Characteristics of living things. • All living things are composed of one or more cells and organized. • Characteristics of viruses • Classification of Life • Evidence of Evolution • Hardy Weinburg (optional) • Natural Selection (micro and macro)	Science and Engineering practices S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S6. Constructing explanations (for science) and designing solutions (for engineering).
Content Objectives "I can Statements"	U1FA1 "I Can Statements" What is life • Identify, construct an explanation, and apply the characteristics of life. • identify, explain, and sort levels or organize levels of life. • Make a claim supported by evidence and reasoning describing why viruses are not classified as living things. U1FA2 "I Can Statements" Classification and Taxonomy • identify the 3 domains and 6 kingdoms, explain their characteristics, and classify an unknown organism into the correct kingdom and domain. • Identify and classify organisms into DKPCOFGS based on taxonomic info • accurately use a dichotomous key • properly use binomial nomenclature. • accurately identify and interpret phylogenetic diagrams and cladograms. U1FA3 "I Can Statements" Evidence of Evolution • Obtaining, evaluating, and communicating the different types of evidence of evolution. U1FA4 "I Can Statements" Mechanisms of Evolution • Model and describe Darwin's theory of evolution by Natural Selection • Make a claim supported by evidence and scientific reasoning to explain how environmental changes may result in the evolution of a species.	
Assessments, vocabulary, products,	U1FA1 Vocabulary What is life • Virus CER U1FA2 Vocabulary Classification and Taxonomy	

practice	• Taxonomy Lab • Phylogenetic Tree Wolf and dogs U1FA3 Vocabulary Honors and College Prep U1FA4 Vocabulary Honors and College Prep Unit summative assessment
Text, Materials, and Resources	Miller and Levine Biology Book • FA1 Section: 1.3 • FA2 Sections: 19.1 & 19.2 • FA3 Sections: 1.1 & 1.2 • FA4 Sections: 2.1, 2.2, 2.3, 2.4 • FA1 Sections: Evidence 17.4 • FA2 Sections: 17.2, 17.3 Savvas Realize

	Biology https://www.doe.mass.edu/frameworks/scitech/2016-04.pdf Biology Syllabus Binder Notebook	
	Unit TWO: Chemistry of Life	
Essential Questions	How do scientists carry out a scientific investigation? What are the most essential elements in living things? What are the 4 types of organic molecules that build living matter?	
Science Standards	HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.	
Concepts and skills	• All living things contain six common elements that build the four macromolecules • The scientific process/method • Living things use different chemical reactions to get the energy needed for life processes.	Science and Engineering practices S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S6. Constructing explanations (for science) and designing solutions (for engineering).
Content Objectives "I can Statements"	U2FA1 "I Can Statements" Scientific Method • Plan and carry out a scientific investigation using the scientific method. • Analyze and interpret data to construct an argument using evidence from your investigation. U2FA2 "I Can Statements" Chemistry of life • identify the 6 most common elements in living things and describe their significance in organic molecules vs inorganic molecules. • Construct and use models to identify the 4 major organic macromolecules and describe their major functions.	

	- Identify, explain, and analyze the chemical bonds used by organic (covalent), hydrogen bonds, and inorganic molecules - Identify, explain, and analyze the properties of water (optional) - Carry out an investigation of the pH scale to analyze and interpret data to construct an argument using evidence from your investigation.
Assessments, vocabulary, products, practice	U2FA1 Vocabulary Scientific Method Experimental design - radish seed lab U2FA2 Vocabulary Chemistry of life Penny Lab (surface tension) pH Indicator Lab Unit summative assessment
Text, Materials, and Resources	Miller and Levine Biology Book - FA1 Section: 1.3 - FA4 Sections: 2.1, 2.2, 2.3, 2.4 Savvas Realize

	MCAS Prep Biology Unit THREE: Introduction to Ecology
Essential Questions	How does matter and energy flow through an ecosystem and the biosphere? How does an ecosystem respond to change? What are human impacts on ecosystems and how should we respond? How do our bodies process energy from food and eliminate wastes?
Science Standards	HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake, and transport through the body; (b) exchange of oxygen and carbon dioxide; (c) removal of wastes; and (d) regulation of body processes.

	MCAS Prep Biology Unit THREE: Introduction to Ecology	
	HS-LS1-7. Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new bonds form, resulting in new compounds and a net transfer of energy. HS-LS2-4. Use a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment. HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.	
Concepts and skills	• An ecosystem is a community of organisms and their abiotic environment. • In an ecosystem, energy flows from the sun to producers to consumers to decomposers. • Energy is stored at each link in a food web, but some energy that is used dissipates as heat into the environment but is not recycled. • The five important functions of the skeletal system are support, protection, movement, mineral storage, and blood cell formation. • The human body contains skeletal, smooth, and cardiac muscle. Muscles	Science and Engineering practices S2. Developing and using models. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking.

	MCAS Prep Biology Unit THREE: Introduction to Ecology	
	switch between two processes to produce ATP. • The digestive system takes in food, breaks it down into molecules that the body can use, and gets rid of undigested molecules and waste. Topic Reference • Biogeochemical (carbon) cycle • Food webs • Trophic levels • Energy in Food • Digestion • Muscle Skeletal system (optional)	
Content Objectives "I can Statements"	U3FA1 <u>"I Can Statements" Biogeochemical Cycles</u> • Model and analyze the Carbon cycle. • Model and analyze the Nitrogen cycle (optional) • Model and analyze the Water cycle. U3FA2 <u>"I Can Statements" Food Webs and Trophic Levels</u> • Create a model and analyze a food web. • Identify, describe, and analyze the characteristics of trophic levels • explain energy transfer within a food web and calculate the amount of energy transferred. U3FA3 <u>"I Can Statements" Digestion</u> • identify the parts and functions of the digestive system and explain how food passes through the body. • explain how food is broken down and nutrients are absorbed.	

	MCAS Prep Biology Unit THREE: Introduction to Ecology
Assessments, products, vocabulary, practice	U3FA1 Vocabulary Honors and College Prep U3FA2 Vocabulary Honors and College Prep U3FA3 Vocabulary Honors and College Prep - Ecology research Project Honors and College Prep - Owl Pellet Lab - VALIDATED
Text, Materials, and Resources	Miller and Levine Biology Book - FA1 Section: 4.3 - FA2 Sections: 4.1 and 4.2 - FA3 Sections: 25.1 - Section: 27.2 (optional) Savvas Realize

	MCAS Prep Biology Unit FOUR: Population Ecology
Essential Questions	What factors affect population growth? What limiting factors affect population density? And how? How can population growth and change be modeled? How do symbiotic relationships affect populations within an ecosystem? How can humans positively and negatively impact the biodiversity of ecosystems?

Science Standards	HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity. HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem. HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience. HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.*	
Concepts and skills	• Understanding population growth is important because populations of different species interact and affect one another, including human populations. • Species that involve predator-prey or parasite host relationships often develop adaptations in response to one another. • Competition for resources between species shapes a species' fundamental niche. • Understanding the impact humans can have on a population, ecosystem and biodiversity. Topic Reference • Types of biological diversity • Biotic and abiotic factors on population ecology	Science and Engineering practices S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information.

	• Symbiotic relationships and disease • Changing ecosystems • Human impacts on biodiversity and ecosystems • Solutions to human impact	
Content Objectives "I can Statements"	U4FA1 "I Can Statements" Populations • identify and describe symbiotic relationships • Analyze population graphs and population data tables and construct an explanation using scientific evidence • identify, explain, and predict biotic and abiotic factors, and how they may affect populations and ecosystems • critically examine data to identify stages of succession. U4FA2 "I Can Statements" Human Impact on biodiversity • Construct an argument about direct and indirect human impacts on the environment, using scientific evidence • identify strategies and solutions for combating negative human impacts on ecosystems. • Obtain, evaluate, and communicate information about an endangered species.	
Assessments, products, vocabulary, practice	U4FA1 Vocabulary Honors and College Prep U4FA2 Vocabulary Honors and College Prep • Ecology research Project Honors and College Prep- VALIDATED • Midterm Summative assessment- VALIDATED	
Text, Materials, and Resources	Miller and Levine Biology Book • FA1 Sections: Ch 5 and 6 • FA2 Sections: Ch 7 Savvas Realize	

	MCAS Prep Biology Unit FIVE: Cells and Homeostasis
--	---

Essential Questions	• What structural characteristics do prokaryotic and eukaryotic cells have in common and what is different? And viruses? • How do humans use their nervous and endocrine system to maintain homeostasis and respond to their environment (internal and external)? • How do cells transport materials in and out of cells?	
Science Standards	HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake, and transport through the body; (b) exchange of oxygen and carbon dioxide; (c) removal of wastes; and (d) regulation of body processes. HS-LS1-3. Provide evidence that homeostasis maintains internal body conditions through both body-wide feedback mechanisms and small-scale cellular processes. HS-LS4-4. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environments. HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.	
Concepts and skills	• A cell's shape reflects the cell's function. • Because of their complex organization, eukaryotic cells can carry out more specialized functions than prokaryotic cells. • The cell membrane maintains homeostasis by controlling the movement of substances across the membrane. • Substances enter and leave the cell through passive transport, osmosis, and diffusion. • The central nervous system responds to internal and external information.	Science and Engineering practices S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S6. Constructing explanations (for science) and designing solutions (for engineering).

	- Electrical signals in the nervous system are caused by the movement of ions across the cell membrane of neurons. - The endocrine system regulates metabolism; salt, water, and nutrient balance in the blood; controls the body's response to stress; and regulates growth, development, and reproduction. Topic Reference - Cell structures and types (lysosomes) - Bacteria/Viruses - Lipids - Cell membrane - Active passive transport - Nervous system - Excretory system - Positive and negative feedback loops	
Content Objectives "I can Statements"	U5FA1 "I Can Statements" Microscopes and cells - Identify the major organelles and their basic function, and compare and contrast eukaryotic and prokaryotic cells - Describe the general structure of a virus and viral cycles, how they reproduce and cause disease - Identify, differentiate, compare, and contrast plant, animal, and fungal cells - Identify components of a compound light microscope and describe how to properly use one - Carry out an investigation properly using a compound light microscope and wet mount slide U5FA2 "I Can Statements" Lipids and transports - Identify, describe and model the structure and function of lipids - Identify, describe and model the role of phospholipids and other structures within the cell membrane - Identify and describe the different types of passive transport (simple diffusion, facilitated diffusion, osmosis).	

	• Carry out a cell transport investigation and make a claim supported by evidence and scientific reasoning. • Identify, describe and analyze different types of active transport (Na⁺/K⁺ pump, endocytosis, exocytosis). U5FA3 “I Can Statements” Nervous and excretory system • Identify the parts of a nerve cell and describe how messages are transmitted in the nervous system • Explain how active and passive transport is related to the Nervous system and excretory system • Explain positive and negative feedback loops, and how they relate to homeostasis
Assessments, products, vocabulary, practice	U5FA1 Vocabulary Honors and College Prep • Microscope Lab- VALIDATED U5FA2 Vocabulary Honors and College Prep • Bubble Lab • Osmosis Potato lab U5FA3 Vocabulary Honors and College Prep
Text, Materials, and Resources	Miller and Levine Biology Book • FA1 Sections: 8.1, 8.2, and 21 • FA2 Sections: 2.3, 8.3. 8.4 • FA3 Sections: 25.4, 26.1, 27.1 and 27.2 Savvas Realize

	MCAS Prep Biology Unit SIX: Cell Respiration and Photosynthesis
Essential Questions	• How do organisms acquire and use energy in the form of ATP at a cellular level? • What is the structure and function of the human cardiovascular and respiratory system?
Science Standards	HS-LS1-2. Develop and use a model to illustrate the key functions of animal body systems, including (a) food digestion, nutrient uptake, and transport through the body; (b) exchange of oxygen and carbon dioxide; (c) removal of wastes; and (d) regulation of body processes.

	HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of sugars and other carbohydrates. HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules. HS-LS1-7. Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new bonds form, resulting in new compounds and a net transfer of energy.	
Concepts and skills	• Organisms' use and store energy in chemical bonds of organic compounds. • In plants, light energy is harvested by pigments located in the thylakoid membrane of chloroplasts. • Cellular respiration is the process used by humans and most other organisms to release the energy stored in the food they consume. • Your body needs energy to breathe, pump blood, and grow. • The cardiovascular system carries nutrients, oxygen, hormones, and wastes throughout the body and distributes heat to maintain homeostasis. • The respiratory system includes air entering nasal passages, flowing through the pharynx, the larynx, the trachea, the bronchial tubes, and finally the bronchioles into the alveoli of the lungs Topic Reference • Carbohydrates • Photosynthesis	Science and Engineering practices S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. Common Core Reading Standards Common Core Math Standards

	• Cell Respiration • Circulatory system • Respiratory system	
Content Objectives "I can Statements"	U6FA1 "I Can Statements" Carbohydrates and photosynthesis • identify, explain and model the molecular structure of carbohydrate monomers and polymers • identify the reactants and products of photosynthesis and describe the significant role of carbohydrates • explain, analyze, and predict how photosynthetic organisms interact with their environment and how environmental factors affect the rate of photosynthesis • explain how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy (sugars) within a eukaryote • Carry out a photosynthesis investigation and make a claim supported by evidence and scientific reasoning. U6FA2 "I Can Statements" Cell Respiration • Identify and explain where and how cell respiration provides energy to living things • identify the reactants and products of Aerobic Cell Respiration and describe the significant role of carbohydrates • explain, analyze, and predict how Cell Respiration impacts the environment and how environmental factors affect the rate of cell respiration • Carry out an anaerobic cell respiration investigation and make a claim supported by evidence and scientific reasoning. U6FA3 "I Can Statements" Respiratory and Circulatory Systems • Identify the major structures of the respiratory systems and describe their function • Identify the major structures of the circulatory systems and describe their function • explain, analyze, and model homeostasis is maintained between respiratory system (Alveoli), circulatory system, and cell respiration	
Assessments, products, vocabulary, practice	U6FA1 Vocabulary Honors and College Prep U6FA2 Vocabulary Honors and College Prep U6FA3 Vocabulary Honors and College Prep	
Text, Materials, and	Miller and Levine Biology Book • FA1 Sections: 2.3 and 9	

Resources	● FA2 Sections: Ch 10 ● FA3 Sections: 27.2 Savvas Realize
------------------	--

	MCAS Prep Biology Unit SEVEN: DNA, DNA Replication and Cell Cycle	
Essential Questions	● What is the life cycle of a cell and how is genetic material passed on during cell division? ● How do cells become specialized for different functions? ● What is genetic material composed of and how does DNA make a copy of itself?	
Science Standards	HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents. HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.	
Concepts and skills	● All newly formed cells require DNA, so before a cell divides, a copy of its own DNA is made for each daughter cell. ● Mitosis is a continuous process that can be observed in four stages: prophase, metaphase, anaphase, telophase. ● Mitosis produces cells that are used during growth, development, repair, and asexual reproduction. ● DNA is the primary material that causes recognizable, inheritable characteristics in related groups of organisms. ● A DNA molecule is shaped like a spiral	Science and Engineering practices S2. Developing and using models. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence.

	staircase and is composed of two parallel strands of linked subunits. • The information in DNA is contained in the order of bases, while the base-pairing structure allows the information to be copied. • In DNA replication, the DNA molecule unwinds, and the two sides split. Then, new bases are added to each side until two identical sequences result. Topic Reference • DNA structure • DNA Replication • Mitosis	
Content Objectives "I can Statements"	U7FA1 “I Can Statements” DNA Structure • Make a claim supported by evidence and scientific reasoning to describe the role of DNA in Heredity • Model and describe the DNA double-helix (monomers of DNA and how they build a DNA polymer) U7FA2 “I Can Statements” DNA Replication • Explain the process of DNA replication and importance of the major enzymes (DNA Polymerase and Helicase) • Explain and calculate Chargaff’s rule U7FA3 “I Can Statements” Cell Cycle and Mitosis • Identify and describe the major steps of a “normal” cell cycle • Explain the roles of chromosomes during cell division and chromosomal end product after cell division • Model and describe what happens during the phases of mitosis and during cytokinesis	
Assessments, products,	U7FA1 Vocabulary Honors and College Prep U7FA2 Vocabulary Honors and College Prep	

vocabulary, practice	U7FA3 Vocabulary Honors and College Prep
Text, Materials, and Resources	Miller and Levine Biology Book ● FA1 Sections: 11.1, 11.2 ● FA2 Sections: 13.1. 13.2 ● FA3 Sections: 13.3 Savvas Realize

	MCAS Prep Biology Unit EIGHT: Proteins, Protein Synthesis and Enzymes	
Essential Questions	● How are genes expressed? ● How do cells make proteins? ● What role do enzymes play in living things, and what affects their function? ● How do mutations affect genes?	
Science Standards	HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life. HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents. HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.	
Concepts and skills	● Gene expression produces proteins by transcription and translation. This process takes place in two stages, both of which involve RNA	Science and Engineering practices S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data.

	- The endocrine system regulates metabolism; salt, water, and nutrient balance in the blood; controls the body's response to stress; and regulates growth, development, and reproduction. Topic Reference - Protein Structure - Protein Synthesis - Enzymes - Other protein functions: Hormones and receptors (+/- feedback loop - insulin)	S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence.
Content Objectives "I can Statements"	U8FA1 "I Can Statements" Protein Structure - Model and describe the structure of protein monomers and polymers - Make a claim supported by evidence and scientific reasoning why proteins are important for all living things. U8FA2 "I Can Statements" Protein Synthesis - Compare and contrast DNA and RNA - Model and describe transcription and translation to explain the roles of DNA and RNA that code for proteins - Make a claim supported by evidence and scientific reasoning how transcription and translation leads to gene expression U8FA3 "I Can Statements" Enzymes - Explain why enzymes are important for living things - Plan and carry out an investigation on enzyme function. - Analyze and interpret data from enzyme investigation to make a claim supported by evidence and scientific reasoning.	
Assessments, products, vocabulary, practice	U8FA1 Vocabulary Honors and College Prep U8FA2 Vocabulary Honors and College Prep U8FA3 Vocabulary Honors and College Prep	

Text, Materials, and Resources	Miller and Levine Biology Book ● FA1 Sections: 2.3, 14.2 ● FA2 Sections: 14.1, 14.2, 14.4 ● FA3 Sections: 2.4 Savvas Realize
---	--

	MCAS Prep Biology Unit NINE: Meiosis and Genetics
Essential Questions	● How is meiosis different from mitosis? ● What is sexual reproduction? ● Where does an organism get its unique characteristics? ● How are different forms of a gene distributed to offspring? ● How can we use probability to predict traits?
Science Standards	HS-LS3-1. Develop and use a model to show how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction. HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during meiosis, (b) mutations that occur during replication, and/or (c) mutations caused by environmental factors. Recognize that mutations that occur in gametes can be passed to offspring. HS-LS3-3. Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns. HS-LS3-4(MA). Use scientific information to illustrate that many traits of individuals, and the presence of specific alleles in a population, are due to interactions of genetic factors and environmental factors.

Concepts and skills	• In sexual reproduction, two parents give genetic material to produce offspring that are genetically different from their parents. • Meiosis makes cells that enable an organism to reproduce sexually and it only happens in reproductive structures. • Gene expression produces proteins by transcription and translation. This process takes place in two stages, both of which involve RNA. • For the most part, genetic differences among organisms originate as some kind of mutation. • Topic Reference • Genetics • Meiosis • Reproduction (optional)	Science and Engineering practices S1. Asking questions (for science) and defining problems (for engineering). S2. Developing and using models. S3. Planning and carrying out investigations. S4. Analyzing and interpreting data. S5. Using mathematics and computational thinking. S6. Constructing explanations (for science) and designing solutions (for engineering). S7. Engaging in argument from evidence. S8. Obtaining, evaluating, and communicating information.
Content Objectives "I can Statements"	U9FA1 "I Can Statements" Meiosis • Model and describe what happens during the phases of meiosis and gamete formation • Explain how meiosis produces genetic variation in offspring and why genetic variation is necessary (crossing over). • Compare and contrast meiosis vs mitosis • Explain how gametes combine to form offspring (fertilization) U9FA2 "I Can Statements" Genetics • Identify and explain the various Mendelian inheritance patterns • Calculate the probability of genotypic and phenotypic ratios of offspring • Make a claim supported by evidence and scientific reasoning to explain how environmental conditions can affect gene expression	

Assessments, products, vocabulary, practice	U9FA1 Vocabulary Honors and College Prep U9FA2 Vocabulary Honors and College Prep
Text, Materials, and Resources	Miller and Levine Biology Book • FA1 Sections: Meiosis 12.4 • FA2 Sections: 12.1, 12.2, 12.3 Savvas Realize