Biology Scope and Sequence

	Quarter: 1	Quarter 2	Quarter 3	Quarter 4
	Cells	**Heredity**	**Evolution**	**Diversity and Independence Ecosystem**
Content	**B.C.1:** Cell structure and function • Structure, function and interrelatedness of cell organelles • Eukaryotic cells and prokaryotic cells **B.C.2:** Cellular processes • Characteristics of life regulated by cellular processes • Photosynthesis, chemosynthesis, cellular respiration, biosynthesis of macromolecules	**B.H.1:** Cellular genetics **B.H.2:** Structure and function of DNA in cells **B.H.3:** Genetic mechanisms and inheritance **B.H.4:** Mutations **B.H.5:** Modern genetics	**B.E.1:** Mechanisms • Natural selection • Mutation • Genetic drift • Gene flow (immigration, emigration) • Sexual selection **B.E.2:** Speciation • Biological classification expanded to molecular evidence • Variation of organisms within species due to population genetics and gene frequency	**B.DI.1:** Biodiversity • Genetic diversity • Species diversity **B.DI.2:** Ecosystems • Equilibrium and disequilibrium • Carrying capacity **B.DI.3:** Loss of Diversity • Climate change • Anthropocene effects • Extinction • Invasive species **B.E.1:** Mechanisms • Natural selection • Mutation • Genetic drift • Gene flow (immigration, emigration) • Sexual selection **B.E.2:** Speciation • Biological classification expanded to molecular evidence • Variation of organisms within species due to population genetics and gene frequency

Resources	**McGraw Hill Biology** **ODE Model Curriculum**	**McGraw Hill Biology** **ODE Model Curriculum**	**McGraw Hill Biology** **ODE Model Curriculum**	**McGraw Hill Biology** **ODE Model Curriculum**
Vocabulary				

Quarter(s) 1-4
During the years of 9-12, all students must become proficient in the use of the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas: **SIA1** Identify questions and concepts that guide scientific investigations. **SIA2** Design and conduct scientific investigations. **SIA3** Use technology and mathematics to improve investigations and communications. **SIA4** Formulate and revise explanations and models using logic and evidence (critical thinking). **SIA5** Recognize and analyze explanations and models. **SIA6** Communicate and support a scientific argument.

Learning Targets: Cells
▫ Explain that the cell is a functioning system (e.g., regulation, homeostasis, cell cycle, and transport); 📚 Identify and describe that the cell has specialized parts for the transport of materials, energy transformation, protein building, waste disposal, and movement; 📚 Describe the role of water and organic molecules in cells (lipids, carbohydrates, nucleic acids, proteins); 📚 Understand the properties of the cellular environment that affect shape and function of enzymes (e.g., pH, temperature, concentration); 📚 Diagram the transformation of energy through ATP and cycling of carbon through cellular processes in cells (e.g., photosynthesis, cellular respiration). 📚 Investigative scenarios that explore abiotic effects on the cell cycle; 📚 Investigative scenarios that determine factors that affect the activity of enzymes on their substrates; 📚 Investigate real-world applications of cells that play a foundational role in engineering and industry (e.g., fermentation, medicine); 📚 Interpret diagrams of photosynthesis, cellular respiration, and/or chemosynthesis connected to a real-world scenario; Interpret diagrams of cells from a variety of organisms connected to a real-world scenario. (e.g., plant vs. animal cells, prokaryotic vs. eukaryotic, cells with or without potassium pump); Interpret diagrams of cellular transport. 📚 Create and interpret graphs or data (e.g., temperature, pH, light, concentration) to explain the rate of enzyme activity in a cell; 📚 Explain how the structure of cellular parts facilitates their function; 📚 Describe regulation of the cellular environment (e.g., homeostasis); 📚 Compare organic molecules and their role in cells; 📚 Describe how photosynthesis and cellular respiration impact the concentration of chemicals in a system; 📚 Use a diagram of the basic stages of photosynthesis (light and dark reactions) identify the major reactants/products (CO_2, H_2O, ATP, O_2, glucose) involved in each stage. 📚 Explain how cell components work together to perform the functions of the cell; 📚 Analyze graphs displaying data about enzyme activity and how that impacts a cell; 📚 Design an experiment to determine the effect of external factors (e.g., pH, temperature, concentration) on the cellular function (e.g., transport, enzyme rate, photosynthesis, cellular respiration);

📚 Evaluate or improving the design of an industrial application of cellular processes (e.g., optimal environment for fermentation, genetically modified organisms).

Learning Targets: Heredity
□ Understand that genes are segments of DNA and code for protein; □ Understand the concept of differentiation – although all cells have identical genetic information, different genes are active in different types of cells; □ Identify cellular and molecular mechanisms for inheritance and the expression of genetic information (e.g., complementary base pairs in DNA and RNA, transcription/translation); □ Comprehend the importance of crossing over, independent assortment, and recombination in producing variation in traits as a result of meiosis; □ Connect Mendel's laws of segregation and independent assortment to the movement of chromosomes (crossing over, sorting, and recombination) during meiosis; □ Explain gene mutations and their short-term and long-term implications; □ Comprehend Mendelian and Non-Mendelian inheritance (e.g., dihybrid crosses, sex-linked traits, linkage, chi-square test); □ Describe the goals of genetic engineering and the role of restriction enzymes. □ Interpret diagrams of DNA to illustrate protein synthesis; □ Interpret diagrams that illustrate crossing over; □ Identify real-world scenario in which chi-squared test data are given; □ Use a codon chart to build a protein; □ Differentiate between parent and daughter cells before and after meiosis; □ Interpret diagrams of a variety of genetic crosses; □ Interpret diagrams of gene sequences showing a mutation; □ Understand different scenarios involving applications of biotechnology and genetic engineering such as cloning, gene therapy, or gel electrophoresis; □ Describe basic historical data from DNA discoveries. □ Demonstrate how the complementary DNA base pairing within genes determines the sequence of amino acids in a protein;

□ Illustrate how non-Mendelian genetics affects inheritance (including Punnett squares); □ Predict the probability of two traits in offspring given the parental genotypes; □ Compare and contrast the genetic makeup of two different types of cells in the same organism; □ Be given chi-squared test data, and make an inference about the inheritance of a set of genes; □ Demonstrate how sorting and recombination of genes in sexual reproduction and meiosis result in variation of traits in offspring; Explain how gene mutations might impact organisms; □ Interpret data from a real-world scenario involving biotechnology (e.g., gel electrophoresis, gene therapy, cloning); □ Explain the importance of historical discoveries after Mendel to our understanding of the structure and function of DNA. □ Explain the scientific implications of a biotechnology (e.g., oil-eating bacteria); □ Be given a scenario, making and justifying conclusions about the type of inheritance involved; □ Design or conduct an investigation involving genetics and inheritance (e.g., fruit flies, fast plants, matching genes to traits); □ Explain the effect that a gene mutation can have on protein synthesis or traits.

Learning Targets: Evolution
Comprehend evolution of a species (change in gene frequency in a population and the Hardy-Weinberg Law); □ Differentiate between mechanisms of speciation (gene flow, mutation, speciation, natural selection, genetic drift, sexual selection); □ Describe evidence for evolution (e.g., fossil record, molecular and structural homology, biogeography). □ State evidence of evolutionary theory from real-world examples (e.g., antibiotic resistant bacteria, fossil record, molecular and structural homology); □ Interpret cladograms showing relationships between species; □ Comprehend different scenarios in which environmental changes influence selective pressure on a population; □ Give examples of speciation between isolated populations (e.g., leopard frogs, anole lizard, Central American hummingbirds); □ Interpret tables or data showing gene frequency changes over time (e.g., bottleneck cheetahs). □ Use mathematical reasoning related to the Hardy-Weinberg Law to explain or predict changes in a population; □ Predict how factors affect evolution of a population or populations; □ Give evidence, determining the relatedness of groups; □ Compare the survivability of traits between populations in different environments; □ Compare evolutionary mechanisms illustrated in a variety of populations. □ Use mathematical reasoning related to Hardy-Weinberg's Law to explain or predict changes in a population; □ Be given data and/or a scenario, making and justifying a conclusion about evolutionary mechanisms in a

population;
□ Explain how variations within populations in a changing environment can lead to evolution;
□ Describe how speciation occurred in two related populations;
□ Use examples to explain how evidence supports the theory of evolution;
□ Give a real-world example, explaining and predict how a population has responded to environmental changes.

Learning Targets: Diversity and Interdependence of Life Ecosystems
□ Understand cyclical fluctuations of ecosystems around a rough state of equilibrium; □ Describe energy flow at ecosystem and molecular levels; □ Classify using morphological and molecular evidence; □ Explain diversity of species and ecological niches resulting from billions of years of evolution; □ Interpret models describing carrying capacity and homeostasis within ecosystems supported with mathematical evidence. □ Interpret population graphs or charts containing authentic, real-world data; □ Interpret diagrams of food chains and webs to explain real-world relationships or events within an ecosystem (e.g., bio magnification, invasive species, energy flow and nutrient cycle changes); □ Comprehend scenarios involving remediation and habitat restoration programs (e.g., fish populations in the Great Lakes); □ Comprehend scenarios involving niche partitioning, competition for resources, immigration/emigration from an ecosystem, or environmental change; □ Interpret and analyze Cladograms; □ Analyze data tables showing genetic relatedness between organisms. □ Use mathematical reasoning to interpret exponential or logistic growth models; □ Design or simulate a population growth model by manipulating environmental conditions; □ Given population graphs or charts containing data, analyzing the history or predict the future of an ecosystem; □ Predict the effect of geological, biological, or environmental changes on a population within an ecosystem (e.g., climate change, deforestation, human development); □ Complete a cladograms to determine relationships among organisms; □ Predict the effect of geological, biological, or environmental changes on a population within an ecosystem (e.g.,

climate change, deforestation, human development); □ Discuss the implications of technology or engineering on an ecosystem (e.g., power plant increasing water temperature); □ Use mathematical models to explain carrying capacity and homeostasis within ecosystems; □ Be given a scenario, designing an experiment to predict the effect of several possible factors on the carrying capacity. □ Use cladograms to compare and contrast the degree of relatedness between organisms.