Biology Scope and Sequence

COURSE OVERVIEW & TIMING This section is designed to help you see the flow of the units/topics across the entire school year.		
	Unit	**Unit Length**
Unit 1:	Diversity and Interdependence of Life	1st Quarter
Unit 2:	Cells	2nd Quarter
Unit 3:	Heredity	3rd Quarter
Unit 4:	Evolution	4th Quarter

OVERALL COURSE TIMING This section is designed to help you compare the number of available instructional days to the number of days accounted for in the Scope and Sequence.	
	Course Length
Total number of instructional days in school year:	176
Total number of instructional days for all units included in Scope and Sequence:	160

Science Inquiry and Application (SIA)
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:
• Identify questions and concepts that guide scientific investigations. • Design and conduct scientific investigations. • Use technology and mathematics to improve investigations and communications. • Formulate and revise explanations and models using logic and evidence (critical thinking). • Recognize and analyze explanations and models. • Communicate and support a scientific argument.

FIRST QUARTER: DIVERSITY AND INTERDEPENDENCE OF LIFE *This topic focuses on the study of diversity and similarity at the molecular level of organisms. Additionally the effects of physical/chemical constraints on all biological relationships and systems are investigated.*	**UNIT 1 LENGTH: Days/Weeks 40**	**Resources**
UNIT 1 STANDARDS		
	Classification systems are frameworks created by scientists for describing the vast diversity of organisms indicating the degree of relatedness between organisms. **Content Elaboration:** Constructing food webs/food chains to show interactions between organisms within ecosystems was covered in upper elementary school & middle school; constructing them as a way to demonstrate content knowledge is not appropriate for this grade. Students may use these diagrams to help explain real-world relationships or events within an ecosystem, but not to identify simple trophic levels, consumers, producers, predator-prey & symbiotic relations. The great diversity of organisms and ecological niches they occupy result from more than 3.5 billion years of evolution. Some ecosystems can be reasonably persistent over hundreds or thousands of years. Like many complex systems, ecosystems tend to have cyclic fluctuations around state of rough equilibrium. In the long run, however, ecosystems always change as geological or biological conditions vary. Ecosystems Homeostasis • Carrying capacity • Equilibrium and disequilibrium **Content Elaboration:** Real-time, authentic data needed to study population changes & growth *Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.* Human populations grow due to advances in agriculture, medicine, construction and the use of energy. Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources. ***Note 1:*** *Exponential growth equation in simplest form, change in population size N per unit time t is a product of r (the per capita reproductive rate) and N (population size).* ***Note 2:*** *Carrying capacity is defined as the population equilibrium sized when births and deaths are equal; hence dN/dt = zero.*	• ODE Model Curriculum • Chapters 3 and 5 • Unit 6 Curriculum Map • Interactive Ecology Lab:www.learner.org/courses/envsci/interactives/ecology/producers_2.php • Predator prey simulation: www.biologycorner.com/worksheets/pred_prey.html#.U17U0YkpAeE • Interactive ecology lab: www.learner.org/courses/envsci/interactives/ecology/food_web_1.php • Examining the stages in ecological succession:www.biologycorner.com/worksheets/examining_stages_succession.html#.U1bhtokpA5s • Interactive carbon cycle lab:www.learner.org/courses/envsci/interactives/carbon/feedback_effects_fyc.php • Cycling of matter self-study and vocabulary acquisition: www.ck12.org/book/CK-12-Biology/r10/section/11.2 • Projects on environmental issues: toxics.usgs.gov/ • Conservation of bald eagle: www.learner.org/north/eagle/index.html • Interpret graph on human population: www.biologycorner.com/worksheets/humanpop_graph.html • Investigate the causes for endangered species: www.biologycorner.com/lesson-plans/ecology/
SPIRALING	**ELA:** RST.9-10.2, RST.9-10.4, W.9-10.1c, W.9-10.4, SL.9-10.4, RST.9-10.2, RST.9-10.3, RST.9-10.4	
ESSENTIAL QUESTIONS	• How do different ecosystems determine the environment of your neighborhood? • How is it possible that a decaying log feeds you? • Describe how you and different populations are interconnected? • How do we decide which scientific claim best supports the disappearance of dinosaurs? • How will the population explosion affect the world in 2020? 2030? • What are the effects of populations of different species on each other?	
VOCABULARY	Biogeochemical cycle, trophic level, ecological succession, food chain, eutrophication, biomagnification, denitrification, transpiration, ecosystems, homeostasis, carrying capacity, equilibrium and disequilibrium, ecology, carrying capacity, population, immigration, emigration, limiting factor	

SECOND QUARTER: CELLS ***Cell structure:*** The cell as a system itself (single-celled organism) and as part of larger systems (multicellular organism), sometimes as part of a multicellular organism, always as part of an ecosystem.	**UNIT 2 LENGTH: Days/Weeks 40**	**Resources**
UNIT 2 STANDARDS		
	Cell structure and function • Structure, function and interrelatedness of cell organelles • Eukaryotic cells and prokaryotic cells Cellular processes • Characteristics of life regulated by cellular processes • Photosynthesis, chemosynthesis, cellular respiration` • Cell division and differentiation ***The cell is a system that conducts a variety of functions associated with life:*** **Content Elaboration:** *From about 4 billion years ago to about 2 billion years ago, only simple, single-celled microorganisms are found in the fossil record. Once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.* *Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape. Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.* *A living cell is composed of a small number of elements, mainly carbon, hydrogen, nitrogen, oxygen, phosphorous and sulfur. Carbon, because of its small size and four available bonding electrons, can join to other carbon atoms in chains and rings to form large and complex molecules. The essential functions of cells involve chemical reactions that involve water and carbohydrates, proteins, lipids and nucleic acids. A special group of proteins, enzymes, enables chemical reactions to occur within living systems.* *Cell functions are regulated. Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Most cells function within a narrow range of temperature and pH. At very low temperatures, reaction rates are slow. High temperatures and/or extremes* **Cell division and differentiation** **Content Elaboration:** Cell functions are regulated primarily by enzymes Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Most cells function within a narrow range of temperature and pH ***Note 1:*** *The idea that protein molecules assembled by cells conduct the work that goes on inside and outside the cells in an organism can be learned without going into the biochemical details. It is sufficient for students to know that the molecules involved are different configurations of a few amino acids and that the different shapes of the molecules influence what they do.* ***Note 2:*** *The concept of the cell and its parts as a functioning system is more important than memorizing parts of the cell.*	• ODE Model Curriculum • Chapters 2, 7-10 • Unit Cells Curriculum Map highered.mcgraw-hill.com/sites/0072919183/student_view0/johnson_explorations.html • Surface area to volume ratio of a cell (introduction to mitosis as well) www.biologyjunction.com/cell_size.htm • Diffusion Lab biologycorner.com/worksheets/diffusionlab.html • Potato Osmosis Lab www.biologyjunction.com/potato_osmosis_bi_lab.htm • chromatography lab www.biologyjunction.com/chromatography_plant_pigments • Developing and testing hypothesis lab: www.lessoncorner.com/l/amfroehle/VitruvianManDataCollection • Properties of life lab: serendip.brynmawr.edu/sci_edu/waldron/pdf/IsYeastAliveProtocol.pdf
SPIRALING	**ELA:** RST.9-10.2, RST.9-10.4, W.9-10.1c, W.9-10.4, SL.9-10.4, RST.9-10.2, RST.9-10.3, RST.9-10.4	
ESSENTIAL QUESTIONS	• How does Cell Theory help us understand living things? • If a cell is like a human being, what kinds of things does it need to do in order to stay alive? • How does the structure of an organelle serve its function? • How do organelles know what to do? • How do materials and organelles move around within the cell? • Does a plant need to eat and breath to stay alive like humans do? If so, how do they do it? • If our cells need certain compounds to survive (ex. Carbohydrates, lipids, proteins), where do we get them and how do we get these compounds to our cells? • How is it that energy in neither created or destroyed in organisms?	
VOCABULARY	Eukaryote, prokaryote, organelle, cytoplasm, golgi body, cell wall, mitochondria, chloroplast, cell membrane, endoplasmic reticulum, vacuole, nucleus, lysosome, ribosome, diffusion, osmosis, plasma, membrane, endocytosis, exocytosis, atp, cellular respiration, metabolism, photosynthesis, pigment, fermentation, chromosome, cell cycle, interphase, mitosis, diploid, stem cell, cancer, grana, stroma, aerobic respiration, anaerobic respiration, glycolysis	

<table>
<tr><td colspan="2">THIRD QUARTER: HEREDITY
Topic: Focus is on the explanations of genetic patterns of inheritance.</td><td>UNIT 3
LENGTH:
Days/Weeks
40</td><td rowspan="2">Resources</td></tr>
<tr><td colspan="3">UNIT 3 STANDARDS</td></tr>
<tr><td></td><td colspan="2">Cellular genetics
Structure and function of DNA in cells
Genetic mechanisms and inheritance
Mutations
Modern genetics

Content Elaboration:
Focus is on the explanations of genetic patterns of inheritance. Both classical and modern genetic mechanisms, including dihybrid crosses, Chi-square, incomplete dominance, and sex-linked traits are investigated through real-world examples. Dihybrid crosses can be used to explore linkage groups. Gene interactions and phenotypic effects can be introduced using real-world examples (e.g. polygenic inheritance, epistasis, and pleiotrophy).

Mutations
Modern genetics

Content Elaboration
Inserting, deleting, or substituting segments of DNA molecules can alter genes.
An altered gene may be passed on to every cell that develops from it.
Features resulting from altered genes may help, harm, or have little or no effect on the offspring's success in its environments.
Sorting and recombination of genes in meiosis creates variance in traits of offspring of any two parents and is connected to evolutionary processes.
Complex patterns of inheritance explain the presence of many traits that do not follow the rules of Mendelian genetics.</td><td rowspan="4">ODE Model Curriculum
Chapters 11, 13, and 14
Unit 3 Curriculum Map
National Institute of Health provides stories, archival sites, & an interactive site about the development of genomes.www.genome.gov/Educators/
Dolan DNA Learning Center has a wealth of educational resources: www.dnalc.org/
Steve Spangler Science: Strawberry DNA Extraction: www.stevespanglerscience.com/lab/experiments/strawberry-dna
Design a timeline from Mendel's, Darwin's andWallace's work to the present day www.learner.org/interactives/dna/history.html
A Science Odyssey: DNA workshop- You Try Itwww.pbs.org/wgbh/aso/tryit/dna/index-nojs.html
McGraw Hill: Biological Concepts & Connections; Interactivity that includes a review of protein synthesis through matching and a 2nd section that allows students to build a protein:
www.mhhe.com/socscience/anthropology/fuentes_lab/03_1/fuentes_3_1.html
Nobelprize.org: DNA The Double Helix; An interactive game that covers major concepts about the structure and function of DNA. This site also has many other related virtual labs and games.www.nobelprize.org/educational/medicine/dna_double_helix/
www.learner.org/interactives/dna/sitemap.html</td></tr>
<tr><td>SPIRALING</td><td colspan="2">ELA: RI.1-10, RL1-10, W 1 (a-e), 2 (a-e), 4-10</td></tr>
<tr><td>ESSENTIAL QUESTIONS</td><td colspan="2">Does biological information encoded in the DNA of an organism's genome relate to its characteristics and traits?
Does the sequence of DNA bases in a chromosome determine the sequence of amino acids in the resulting protein?
Do alterations in DNA affect the success of an offspring in its environment?
Can non-Mendelian patterns of inheritance account for inherited traits?</td></tr>
<tr><td>VOCABULARY</td><td colspan="2">Dihybrid crosses, Chi-square, incomplete dominance, sex-linked traits, gene, mutation, dominant, recessive, allele, amino acid, polygenic inheritance, epistasis, pleiotroph, Mendel, chromosome, chromatid, DNA, RNA</td></tr>
</table>

FOURTH QUARTER: EVOLUTION **Topic:** The basic concept of evolution is that the Earth's present-day species descended from earlier, common ancestral species.	**UNIT 4 LENGTH: Days/Weeks 40**	**Resources**
UNIT 4 STANDARDS		
	Mechanisms • Natural selection • Mutation • Genetic drift • Gene flow (immigration, emigration) • Sexual selection • History of life on Earth • Hardy Weinberg's law can explain gene frequencies in a population **Topic:** Modern ideas about evolution provide a natural explanation for the diversity of life on Earth as represented in the fossil record, in the similarities of existing species and in modern molecular evidence. Diversity of Life • Speciation and biological classification based on molecular evidence • Variation of organisms within a species due to population genetics and gene frequency ***Content Elaboration*** • Evolution is the descent with modification of different lineages from common ancestors. • Different phenotypes result from new combinations of existing genes or from mutations of genes in reproductive cells. • Populations evolve over time. Evolution occurs from interactions of: Potential for a population to increase its numbers; Genetic variability; Finite supply of resources; • Differential survival and reproduction of individuals with specific phenotypes	• ODE Model Curriculum • Chapter 15 • Unit 4 Curriculum Map • www.khanacademy.org/science/biology/evolution-and-natural-selection/v/introduction-toevolution-and-natural-selection • www.pbs.org/wgbh/evolution/educators/course/index.html • www.biomanbio.com/GamesandLabs/EvoClassGames/evolution.html • www.indiana.edu/~ensiweb/evol.fs.html • www.phschool.com/science/biology_place/labbench/lab8/intro.html • www.pbs.org/wgbh/evolution/change/family/ • www.biologycorner.com/worksheets/pepperedmoth.html
SPIRALING	ELA: RI.1-10, RL1-10, W 1 (a-e), 2 (a-e), 4-10	
ESSENTIAL QUESTIONS	• Can environmental changes determine the frequency of expressed traits in a population due to the biological mechanism of natural selection? • Can mathematical reasoning be used to solve problems? • Can real-world problems be solved based on our current understanding of natural selection, gene flow, and sexual selection? • Can mutations, limited resources, and the differential survival and reproduction of individuals with specific phenotypes combine and act as a driving force in the evolution of populations?	
VOCABULARY	Evolution, natural selection, mutation, genetic drift, gene flow, immigration, emigration, sexual selection, modern synthesis, Hardy-Weinberg, gene frequencies, speciation	