Jones County Schools
Biology
Pacing Guide

JCS
Biology
Pacing Guide

Overview

1st Nine Weeks	2nd Nine Weeks	3rd Nine Weeks	4th Nine Weeks
Science and Engineering Practices *Scientific Thinking and Processes* *Tools and Technology* **Safety** **Norms of Scientific Investigations** **Introduction to Labs and Lab Reports** **The Study of Life** **Unifying Themes in Biology** **Characteristics of Life** *BIO.1A.1-living vs nonliving* *BIO.1A.4- viruses* *BIO.1B.1-macromolecules* *BIO.1B.2- enzymes* **Cellular Organelles** *BIO.1A.2-cell theory; scientists* *BIO.1A.3-levels of organization* *BIO.1C.1-cell organelles* *BIO.1C.2-prokaryotic/eukaryotic cells; plant /animal/ fungal cells* *BIO.1C.3-comparing viruses to cells* **Cellular Transport** *BIO1D.1-cell membrane; active and passive transport* *BIO1D.2-regulating cellular*	**Energy Transfer** *BIO2.1-ATP/ADP* *BIO2.2-photosynthesis* *BIO2.3- cellular respiration* *BIO 2.4-aerobic vs anaerobic* **Cell Growth and Division** *BIO.1E.3 asexual reproduction* *BIO.1E.2-cell cycle; cancer* *BIO1E.1-mitosis* *BIO3A.1-meiosis* *BIO.3A.3-chromosomal abnormalities* **Mendelian Genetics** *BIO.3B.1-Mendel's Law of Dominance/Punnett Squares* *BIO.3B.2-Mendel's Law of Independent Assortment/Punnett Squares*	**Genetics** *BIO.3B.3-Non-Mendelian inheritance patterns* *BIO.3B.4-Analyze and interpret data (pedigrees, family/population studies)* **DNA and Protein Synthesis** *BIO.3C.1-DNA/genes/chromosomes* *BIO.3A.3-chromosomal abnormalities* *BIO.3C.2-protein synthesis* *BIO.3C.3-nucleotide sequence; mutations* *BIO.3C.4-DNA technology* **Adaptations and Evolution** *BIO.4.3-cladograms* *BIO.4.6-mechanisms of speciation* *BIO.4.4-natural selection* *BIO.4.5-Darwin's theory of evolution by natural selection* *BIO.4.1-organic/chemical evolution* *BIO.4.2-evidence for biological evolution(homologous structures, embryological similarities, fossil record, molecular/biochemical similarities, biogeographical distribution)*	**Ecology** *BIO.5.1-levels of ecological hierarchy* *BIO.5.2-abiotic/biotic factors, cycling of matter* *BIO.5.3-effects of greenhouse gases* *BIO.5.4-flow of energy/food chains/food webs/energy pyramids* *BIO.5.5-ecological relationships* *BIO.5.6-population studies/limiting factors/carrying capacity* *BIO.5.7-ecological succession*

transport; homeostasis			

JCS Biology Pacing Guide

1st 9 Weeks		
	Unit(s)	Standard
The Study of Life	**Unifying Themes in Biology** ***Characteristics of Life***	**BIO.1 Cells as a System** ***BIO.1A*** ***Students will demonstrate an understanding of the characteristics of life and biological organization.*** **Conceptual Understanding**: *Biologists have determined that organisms share unique characteristics that differentiate them from non-living things. Organisms range from very simple to extremely complex.* **BIO.1A.1** Develop criteria to differentiate between living and non-living things. **BIO.1A.4** Use evidence from current scientific literature to support whether a virus is living or non-living. ***BIO.1B*** ***Students will analyze the structure and function of the macromolecules that make up cells.*** **Conceptual Understanding**: *Organisms are composed of four primary macromolecules: carbohydrates, lipids, proteins, and nucleic acids. Metabolism*

	Cellular Organelles	*is the sum of all chemical reactions between molecules within cells. Cells continuously utilize materials obtained from the environment and the breakdown of other macromolecules to synthesize their own large macromolecules for cellular structures and functions. These metabolic reactions require enzymes for catalysis.* **BIO.1B.1** Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms. **BIO.1B.2** Design and conduct an experiment to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms. ***BIO.1A*** ***Students will demonstrate an understanding of the characteristics of life and biological organization.*** **BIO.1A.2** Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow **BIO.1A.3** Using specific examples, explain how cells can be organized into complex tissues, organs, and organ systems in multicellular organisms. ***BIO.1C*** ***Students will relate the diversity of organelles to a variety of specialized cellular functions.*** ***Conceptual Understanding:*** *Cells are the basic units of all organisms, both prokaryotes and eukaryotes. Prokaryotic and eukaryotic cells differ in key structural features, but both can perform all functions necessary for life.* **BIO.1C.1** Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria, chloroplast, centrosomes, and vacuoles) interact to carry out the functions necessary for organism survival. **BIO.1C.2** Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells. **BIO.1C.3** Contrast the structure of viruses with that of cells, and explain why viruses must use living cells to

	Cellular Transport	reproduce. ***BIO.1D*** ***Students will describe the structure of the cell membrane and analyze how the structure is related to its primary function of regulating transport in and out of cells to maintain homeostasis.*** ***Conceptual Understanding:*** *The structure of the cell membrane allows it to be a selectively permeable barrier and maintain homeostasis. Substances that enter or exit the cell must do so via the cell membrane. This transport across the membrane may occur through a variety of mechanisms, including simple diffusion, facilitated diffusion, osmosis, and active transport.* **BIO.1D.1** Plan and conduct investigations to prove that the cell membrane is a semi-permeable, allowing it to maintain homeostasis with its environment through active and passive transport processes. **BIO.1D.2** Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hypertonic, hypotonic, and isotonic conditions, sodium/potassium pump).

2nd 9 Weeks		
	Unit(s)	Standard
	Energy Transfer	**BIO.2 Energy Transfer** ***BIO.2*** ***Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.*** **Conceptual Understanding**: *Organisms require energy to perform life functions. Cells are transformers of energy, continuously utilizing a complex sequence of reactions in which energy is transferred from one form to another, for example, from light energy to chemical energy to kinetic energy. Emphasis is on illustrating the inputs and outputs of matter and the transfer and transformation of energy in photosynthesis and cellular respiration. Assessment is limited to identification of the phases (i.e., glycolysis, citric acid cycle, and electron transport chain) in cellular respiration as well as light and light-independent reactions of photosynthesis and does not include specific biochemical reactions within the phases.* **BIO2.1** Use models to demonstrate that ATP and ADP are cycled within a cell as a means to transfer energy. **BIO2.2** Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored. **BIO2.3** Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored. **BIO2.4** Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.
	Cell Growth and Division	**BIO.1 Cells as a System** ***BIO.1E*** ***Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.*** **Conceptual Understanding**: *Cells grow and reproduce through a regulated cell cycle. Within multicellular organisms, cells repeatedly divide for repair, replacement, and growth. Likewise, an embryo begins as a single cell that reproduces to form a complex, multicellular organism through the processes of cell division and differentiation.* **BIO.1E.3** Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.

	Mendelian Genetics	**BIO.1E.2** Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer). **BIO.1E.1** Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms. **BIO.3 Reproduction and Heredity** ***BIO.3A*** ***Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.*** **Conceptual Understanding**: *Somatic cells contain homologous pairs of chromosomes, one member of each pair obtained from each parent, that form a diploid set of chromosomes in each cell. These chromosomes are similar in genetic information but may contain different alleles of these genes. For sexual reproduction, an offspring must inherit a haploid set from each parent. Haploid gametes are formed by meiosis, a specialized cell division in which the chromosome number is reduced by half. During meiosis, members of a homologous pair may exchange information and then are randomly sorted into gametes resulting in genetic variation in sex cells.* **BIO.3A.1** Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell. **BIO.3A.3** Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes). ***BIO.3B*** ***Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.*** **Conceptual Understanding**: *Offspring inherit DNA from their parents. The genes contained in the DNA (genotype) determine the traits expressed in the offspring's phenotype. Alleles of a gene may demonstrate various patterns of inheritance. These patterns of inheritance may be followed through multiple generations within families.* **BIO.3B.1** Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs.

		BIO.3B.2 Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze monohybrid crosses.

3rd 9 Weeks		
	Unit(s)	Standard
	Genetics	***BIO.3B*** ***Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.*** **Conceptual Understanding**: *Offspring inherit DNA from their parents. The genes contained in the DNA (genotype) determine the traits expressed in the offspring's phenotype. Alleles of a gene may demonstrate various patterns of inheritance. These patterns of inheritance may be followed through multiple generations within families.* **BIO.3B.3** Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage). **BIO.3B.4** Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.
	DNA and Protein Synthesis	***BIO.3C*** ***Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.*** **Conceptual Understanding**: *Gene expression results in the production of proteins and thus determines the phenotypes of the organism. Changes in the DNA occur throughout an organism's life. Mutations are a source of genetic variation that may have a positive, negative, or no effect on the organism.* **BIO.3C.1** Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring. ***BIO.3A*** ***Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.*** **Conceptual Understanding**: *Somatic cells contain homologous pairs of chromosomes, one member of each pair obtained from each parent, that form a diploid set of chromosomes in each cell. These chromosomes are similar in genetic information but may contain different alleles of these genes. For sexual reproduction, an offspring must inherit a haploid set from each parent. Haploid gametes are formed by meiosis, a specialized cell division in which the chromosome number is reduced by half. During meiosis, members of a homologous pair may exchange information and then are randomly sorted into gametes resulting in genetic variation in sex cells.*

	Adaptations and Evolution	**BIO.3A.3** Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes). ***BIO.3C*** ***Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.*** **Conceptual Understanding**: *Gene expression results in the production of proteins and thus determines the phenotypes of the organism. Changes in the DNA occur throughout an organism's life. Mutations are a source of genetic variation that may have a positive, negative, or no effect on the organism.* **BIO.3C.2** Evaluate the mechanisms of transcription and translation in protein synthesis. **BIO.3C.3** Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait. **BIO.3C.4** Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis). **BIO.4 Adaptations and Evolution** ***BIO.4*** ***Students will analyze and interpret evidence to explain the unity and diversity of life.*** **Conceptual Understanding**: *Evolution is a key unifying principle in biology. Differentiating between organic and chemical evolution and the analysis of the gradual changes in populations over time, helps students understand common features and differences between species and thus the relatedness between species. There are several factors that affect how natural selection acts on populations within their environments leading to speciation, extinction, and the current diversity of life on earth.* **BIO.4.3** Construct cladograms/phylogenetic trees to illustrate relatedness between species. **BIO.4.6** Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation).

		BIO.4.4 Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations. **BIO.4.5** Use Darwin's Theory to explain how genetic variation, competition, overproduction, and unequal reproductive success act as driving forces of natural selection and evolution. **BIO.4.1** Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs. **BIO.4.2** Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution.

4th 9 Weeks		
	Unit(s)	Standard
	Ecology	**BIO.5 Interdependence of Organisms and Their Environments** ***BIO.5*** ***Students will Investigate and evaluate the interdependence of living organisms and their environment.*** ***Conceptual Understanding***: *Complex interactions within an ecosystem affect the numbers and types of organisms that survive. Fluctuations in conditions can affect the ecosystem's function, resources, and habitat availability. Ecosystems are subject to carrying capacities and can only support a limited number of organisms and populations. Factors that can affect the carrying capacities of populations are both biotic and abiotic.* **BIO.5.1** Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere. **BIO.5.2** Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem. **BIO.5.3** Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases on the carbon dioxide cycle and global climate. **BIO.5.4** Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids. **BIO.5.5** Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments. **BIO.5.6** Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems. **BIO.5.7** Investigate and evaluate factors involved in primary and secondary ecological succession using local, real world examples.