Moon Area School District Curriculum Map

Course: Applied Biology
Grade Level: 10
Content Area: Science
Frequency: Full-Year Course

Big Ideas

1. Certain characteristics are common to all living things.
2. Water is essential to life.
3. Acids and bases differ in their H+ concentration
4. Carbon-based molecules are the foundation of all living organisms.
5. The building blocks of carbohydrates are monosaccharides and disaccharides are formed by joining two monosaccharides.
6. Polysaccharides are used for energy storage and structure in plants and animals.
7. Lipids are made up of glycerol and fatty acids and they function as sources of energy and in the structure of cell membranes.
8. Proteins are the "work horses" of the cell, playing important roles in structure and function.
9. Enzymes allow chemical reactions that are critical to life to occur.
10. Enzyme activity is specific to each enzyme and is affected by a variety of factors.
11. Nucleic acids exist in two types, each with unique functions and solving the structure of DNA involved many experiments, over many years.
12. DNA replicates by making a strand that is complementary to each original strand.
13. DNA is transcribed into RNA in the nucleus.
14. RNA is translated into proteins at the ribosomes.
15. Cells are the structural and functional units of all living organisms.
16. Eukaryotic cells contain organelles that carry out specific functions.
17. Passive transport moves substances into, out of, and within the cell without the use of energy.
18. Active transport moves substances into, out of, and within the cell by using energy.
19. All cells need chemical energy (ATP) to function, and photosynthesis transforms light energy into glucose and ATP.
20. Organisms obtain energy by breaking down organic molecules through cellular respiration and formation.
21. Cells go through a life cycle that includes interphase, mitosis, and cytokinesis.
22. Mutations in DNA affect protein synthesis.
23. Gregor Mendel established the inheritance pattern of specific traits and Punnett squares allow for the calculation of probability.
24. Meiosis produces haploid gametes, which pass on genetic traits.
25. Complex inheritance of traits does not follow Mendelian genetics.
26. Human blood types are determined by multiple alleles and some genetic disorders can be caused by alleles on autosomes or sex chromosomes.
27. Genetic Engineering has an important place in todays society.
28. Charles Darwin proposed a Theory of Natural Selection that explains the mechanism for how modern species appeared.
29. Species change over time.
30. Diversity is important for the survival of species.

31. Species interact in their environment to have an impact on the Earth.
32. Energy will flow through the ecosystem from the Sun.
33. Nutrients cycle through the ecosystem
34. There are several types of interactions in ecosystems between groups of species.
35. Ecosystems evolve over time.

Essential Questions

36. What characteristics determine whether something is living or non-living?
37. What are some of the properties of water and how does they relate to life on earth?
38. What is the difference between acids and bases and how does pH affect organisms?
39. Why is carbon such an essential molecule for life?
40. How are monosaccharides joined together and taken apart?
41. What functions do polysaccharides perform in the cell?
42. What are the building blocks of lipids and what are their functions in the body?
43. What are the building blocks of proteins and what are their functions in the body?
44. Why are enzymes important to living organisms and how do they affect reaction time?
45. What factors in an environment can affect enzyme activity?
46. What are the building blocks of nucleic acids and what are their functions in the body?
47. Why is it important that DNA can undergo replication and why it is considered semi-conservative?
48. How are DNA and RNA similar and different and what are their functions?
49. How are DNA and RNA similar and different and what are their functions?
50. What characteristics do all cells have and how can we differentiate prokaryotes and eukaryotes?
51. How does structure and function of organelles differ?
52. Why is it important for the cell to use passive transport to move substances?
53. Why is it important for the cell to use active transport to move substances?
54. How do autotrophs obtain energy through photosynthesis?
55. How do heterotrophs obtain energy through cellular respiration?
56. What are the parts of the cell cycle and how is it regulated?
57. What causes mutations and what are the different types in living organisms?
58. Where do alleles come from and how can we predict which traits will be passed on?
59. How does meiosis differ from mitosis?
60. What other types of inheritance patterns do we see in organisms?
61. How are human patterns such as blood type and genetic disorders determined?
62. How does genetic engineering affect our lives?
63. How did Charles Darwin's experiences and observations lead to the theory of natural selection being the mechanism for evolution?
64. How do species change over time?
65. Why is diversity important for the survival of a species?
66. How do species interactions occur and what are the outcomes of those interactions?
67. How does energy flow through the ecosystem?
68. How are nutrients recycled among organisms and ecosystems in the biosphere?
69. What are the main types of interactions in an ecosystem?
70. How does ecological succession eventually culminate in a stable climax community?

Primary Resource(s) & Technology:
Textbook Series, Microsoft Teams, Promethean Boards, Student Laptops/iPads

Pennsylvania and/or focus standards referenced at:
www.pdesas.org
www.education.pa.gov

Big Ideas/ EQs	Focus Standard(s)	Assessed Competencies (Key content and skills)	Timeline
1, 36	3.1.B.A1 Eligible Content: BIO.A.1.1.1 BIO.A.4.2.1	• Identifying the characteristics of all living things. • Differentiating between things that are currently alive, were alive at one time and were never living. • Understand the relationship between living and dead, describing what characteristics the object fails to meet	August - September (5 Days)
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46	3.1.B.A5, 3.1.B.A8 3.1.B.A2, 3.1.B.A7, 3.1.B.B1 Eligible Content: BIO.A.2.1.1, BIO.A.2.2.2, BIO.A.2.2.3,	• Atoms, elements, and compounds • Explain the differences between solutions and suspensions • Describe and identify mixtures, solute, and solvent • Describe the differences of acids and bases and identify substances as acidic, basic, or neutral • Identify compounds as either organic or inorganic • Chemical bonding	September (4 Days)
12, 13, 14, 47, 48, 49	3.1.B.B1, 3.1.B.B3, Eligible Content: BIO.B.2.2.2, BIO.B.2.1.2, BIO.B.2.2.1	• Describe the six major properties of water • Identify compounds as either organic or inorganic • Differentiate between monomers and polymers • Identify and describe the functions, chemical formulas, and shapes/general structures of carbohydrates, lipids, proteins, and nucleic acids • Give examples of the monomer, dimer and polymer of carbohydrates, lipids, proteins, and nucleic acids • Describe enzymes, substrates, active site and activation energy • Relate energy changes to chemical reactions • Describe the importance of enzymes to living organisms	September-October (3 weeks)

		• Describe how an enzymes shape relates to its function and discuss the factors that can change the activity of an enzyme	
12, 13, 14, 47, 48, 49	3.1.B.B1, 3.1.B.B3, Eligible Content: BIO.B.2.2.2, BIO.B.2.1.2, BIO.B.2.2.1	• Describe and summarize the experiments leading to the discovery of DNA as genetic material • Diagram and label the basic structure of DNA • Describe how DNA is related to genes and chromosomes • Identify and describe the structure of a DNA nucleotide • Summarize the process of DNA replication, including the enzymes involved in the process • Identify the location and purpose of transcription and translation • Summarize the process of transcription and translation, including the enzymes involved in each process • Describe the differences (4) between DNA and RNA • Differentiate between the various types of RNA and describe their function • Describe a codon and explain its significance in the role of transcription//translation • Demonstrate the process of transcription/translation when given a specific strand of DNA	October-November (4 weeks)
15, 16, 17, 18, 50, 51, 52, 53	3.1.B.A1, 3.1.B.A5 Eligible Content: BIO.A.1.2.1, BIO.A.1.1.1, BIO.A.1.2.2, BIO.A.4.1.1, BIO.A.4.1.2, BIO.A.4.1.3	• Describe the three principles of the cell theory • Identify and describe the tools scientists use to aide in their work with cells, compound light microscopes, electron microscopes • Differentiate between a prokaryotic and eukaryotic cell, comparing their size, nucleus, and membrane bound organelles • Describe the structure and identify all functions of a cell membrane • Describe the structure of a phospholipid • Differentiate between the areas of the membrane and describe them as hydrophilic or hydrophobic • Identify and describe the characteristics of polar and non-polar areas of the cell membrane • Describe the function of phospholipids, proteins, carbohydrates, and cholesterol in a cell membrane	December (3-4 weeks)

		• When given a diagram of a lipid bilayer, identify the various molecules and describe their properties • Identify the organelles that are unique to plant cells and describe their functions • Describe the functions of the endoplasmic reticulum (smooth and rough) and Golgi apparatus and identify them when given a picture of the cell • Explain the processes of diffusion, osmosis, facilitated diffusion, and active transport in terms of; energy use, concentration gradients, membrane proteins involved. • Differentiate similarities and differences between the four methods of membrane transport • Identify the primary method of membrane transport for oxygen, carbon dioxide, glucose, and water • Describe the difference between active and passive transport • Identify all types of membrane transport as active or passive • Predict the effect of a hypotonic, hypertonic, or isotonic solution on a cell • When given relative solute concentrations, identify a solution as hypotonic, hypertonic, or isotonic and describe the movement of water in each type of solution • Describe the new characteristics of an isotonic solution if more solute is added or more solvent is added • Describe the processes of endocytosis and exocytosis • Describe the difference between phagocytosis and pinocytosis	
19, 20, 54, 55	3.1.B.A2 Eligible Content: BIO.A.3.1.1, BIO.A.3.2.1, BIO.A.3.2.2,	• Compare and contrast autotrophs and heterotrophs • Identify which type(s) of organism use organic molecules as a source of energy • Describe how ATP works in a cell • Name and identify all the components of an ATP molecule • Describe the energy change that occurs when a phosphate is added to or removed from a molecule • Summarize the stages of cellular respiration • Define and describe the terms cellular respiration, aerobic, anerobic, fermentation	January (3-4 weeks)

		• Write the overall equation for cellular respiration • Describe why the presence/absence of oxygen determines which reactions occur in respiration • Identify the waste products of cellular respiration • Compare the end products of aerobic respiration to the end products of anaerobic respiration • Identify the electron carriers used in cellular respiration • Identify the stages that make use of electron carriers • Compare alcoholic and lactic acid fermentation in terms of the net gain of ATP for each process, the molecules produced by each process, and the organisms that are able to carry out each process. • Identify the starting molecules, ending molecules (including number of each), and location of the following processes: glycolysis, Krebs Cycle, Electron Transport Chain, Alcoholic Fermentation, Lactic Acid Fermentation • Identify for the stages of cellular respiration how many of each of the following molecules are made per glucose molecule and per pyruvic acid molecule: NADH, $FADH_2$, ATP and CO_2 • Describe how the body uses or removes each product made during glycolysis, Krebs Cycle, ETC or Fermentation • Explain how the color of an object can indicate the color of light that is being absorbed • Describe why a plant needs pigments in order for photosynthesis to occur • Explain the way our eyes perceive color and how that relates to leaves changing color in the fall • Identify the overall equation for photosynthesis • Define photosynthesis in terms of energy and molecules • Identify the reactants and the products of photosynthesis • Describe the role of chlorophyll in photosynthesis • Identify the organelle responsible for photosynthesis • Describe the process of photosynthesis • For the light dependent and light independent reactions identify the starting molecules (including number), the ending molecules	

		(including number) and where the reaction occurs. • Describe the electron carriers used in photosynthesis • Identify and describe the function of each leaf structure in a leaf cross section • Describe the process of transpiration, explaining the role of the stomata in the process • Identify the environmental conditions that cause a stoma to open or close • Describe the alternative pathways for photosynthesis and the type of plants that use them	
21, 22, 56, 57	3.1.B.A3, 3.1.B.A4, Eligible Content: BIO.B.1.1.1,	• Describe why cells need to be small and relate that to the cells surface area to volume ratio • Describe in order the five stages of the Cell Cycle, including the key events that occur in each stage • Describe the importance of the S Phase of the cell cycle • Identify if a cell is in interphase from a picture • Compare the genetic content of a parent cell with the genetic content of a daughter cell cells created via cell division • Describe the functions of a centromere and sister chromatids • Describe the four stages of Mitosis in order and discuss the changes that happen inside of the cell with each stage. • When given a cellular event, identify the stage of mitosis (or cell cycle) that is being described • Explain why cytokinesis occurs differently in plant and animal cells. • Describe the function of a cell plate. • Identify from photos the stages of the cell cycle and describe the stage/phase pictured as well as the one that occurs before or after • Define and describe cancer and its relationship with the cell cycle • Differentiate between malignant and begin tumors • Identify and describe the factors that lead to cancer development • Describe the functions between proto-oncogenes and tumor suppressor genes. • Describe how non-genetic factors contribute to cancer, such as carcinogens, x-rays, uv light and viruses	February (2 weeks)

		• Differentiate between the types of treatments for cancer • Differentiate between adult and embryonic stem cells • Identify the characteristic of stem cells that makes them useful in modern medicine. • Describe what is meant when a cell is described as totipotent, multipotent, or pluripotent. • Describe what occurs to a cell when it undergoes differentiation. • Identify sources of embryonic stem cells and adult stem cells	
23, 58	3.1.B.B1, 3.1.B.B2, 3.1.B.B5, Eligible Content: BIO.B.1.1.1, BIO.B.1.1.2, BIO.B.1.2.2, BIO.B.2.1.1	• Define haploid and diploid and compare the amount of genetic material in the two types of cells • When given a cell description, identify the cell as a body cell or gamete and as haploid or diploid • Describe the stages of Meiosis, noting the changes that occur within the cell • When given a cellular event, identify the stage of meiosis that is being described • When given a picture of a diploid cell from any species, identify a haploid cell that could be created as a result of meiosis • When given a picture of a cell, identify the stage of meiosis that is occurring • Describe how the process of meiosis reduces the number of chromosomes within a cell • Analyze and describe the importance of meiosis in providing genetic variation • Explain why crossing over increases genetic variation within a species • When given an individual's genotype, identify gametes that are possible only if crossing over has occurred • Describe how meiosis occurs differently in males and females • Describe Gregor Mendel's contribution to modern genetics • In terms of offspring, describe the difference between a self-pollinated plant and a cross-pollinated plant • Describe the patterns that Mendelian genetics explains • Identify the P generation, F1 generation, and F2 generation of an inheritance study	February-March (3 weeks)

		• Identify the genotype of an individual when given the characteristics of the individual's parents or offspring • Explain the difference between a genotype and a phenotype • Explain the principles of dominance, segregation, and independent assortment • When given a diploid genotype, demonstrate all of the possible chromosome combinations that are possible in a gamete from the same individual • Demonstrate the principles of probability using Punnett Squares (monohybrid and dihybrid) • Predict the genotypes and phenotypes of the F1 generation and F2 generation of an inheritance study (when given the parent information). • Explain what is meant when traits are described as linked • Relate the proximity of two genes to their relative chance of being separated during crossing over	
24, 25, 26, 59, 60, 61	3.1.B.B1, 3.1.B.B2, 3.1.B.B5; Eligible Content: BIO.B.1.1.2 BIO.B.2.1.1; BIO.B.1.2.2; BIO.B.2.1.2	• Analyze genetic patterns to determine dominant or recessive inheritance patterns. • Summarize the symptoms of several dominant, recessive, and sex-linked genetic disorders. • Describe a pedigree and explain how they are used. • When given a pedigree (complete or incomplete), identify the genotype and/or phenotype of each individual • Explain the meanings of various symbols used in a pedigree (circles, squares, shading, horizontal lines, vertical lines, etc) • Construct a human pedigree from genetic information • Use the genetic information in a pedigree to make predictions about offspring genotypes and/or phenotypes • When given the characteristics of parents and offspring, identify the pattern of inheritance that is being demonstrated (incomplete dominance, co-dominance, sex-linked). • When given a pedigree, identify the pattern of inheritance that is being demonstrated • Explain the difference between co-dominance and incomplete dominance • Use knowledge of co-dominance and multiple alleles to predict inheritance of blood type.	March-April (3 weeks)

		• Identify all possible blood types a person may safely receive in a transfusion when given his/her blood type • Describe what is meant if a trait is described as sex-linked. • Describe the difference in inheritance patterns between men and women if a trait is inherited on the X chromosome • Describe polygenic traits • Describe a karyotype and distinguish normal karyotypes from those with abnormal karyotypes • Describe nondisjunction and relate the effect of nondisjunction to genetic diseases such as Down Syndrome • Summarize the symptoms and karyotype of several chromosome disorders • Assess the benefits and risks of diagnostic fetal testing such as amniocentesis and Chorionic villus sampling • Define the term genome • When given a DNA sequence identify the type of mutation that has occurred (substitution, frameshift, insertion, deletion, translocation, duplication, inversion) • When given a DNA mutation, identify if the mutation will change one amino acid or many amino acids in the resulting protein	
27, 62	3.1.B.B4 Eligible Content: BIO.B.2.1.2, BIO.B.2.3.1	• Describe selective breeding and discuss the various methods, including inbreeding and hybridization • Describe several advantages to selective breeding in agriculture • Describe several disadvantages of selective breeding • Describe what is meant when an organism is described as transgenic • Describe the process of genetic engineering, explaining why bacteria are commonly used in the process. • Describe recombinant DNA • Identify reasons that genetic engineering would be more useful than selective breeding • Analyze the possible costs and benefits of potential genetic technologies	April (1 week)

28, 29, 30, 63, 64, 65	3.1.10.C1; 3.1.10.C2; 3.1.10.C3; 3.1.10.C4; 3.1.B.C1; 3.1.B.C3 Eligible Content: BIO.B.3.1.1; BIO.B.3.1.2; BIO.B.3.2.1; BIO.B.3.1.3	• Use information from a geologic time scale to identify past trends in life on Earth • Describe how the fossil record provides a record of past life forms • When given a geological process, describe the type of fossil that can be created. • Compare the type of information and/or the amount of detail that different types of fossils are able to preserve. • Describe the three methods that are used to determine the age of fossils • Compare the advantages and disadvantages for relative dating, C_{14} dating, and uranium dating • When given the amount of carbon-14 in a fossil, use the half-life of C14 to determine the age of the fossil • When given a fossilized tree ring, identify changes in climate and when they occurred • Analyze the usefulness of the Galapagos Islands when studying natural selection • Identify personal experiences that contributed to Darwin's thinking about evolution • Outline the four principles of Darwin's theory of evolution by natural selection • Compare and contrast Darwin's ideas with those of Lamark • Define evolution and natural selection, and describe how natural selection relates to evolution • Define competition • Explain how overproduction and genetic variation contribute to natural selection • Explain, using the steps of natural selection, why a population would be different after an environmental change • Compare/contrast natural selection to artificial selection • List and define the kinds of data (patterns) that Darwin helped to explain • For each type of evidence for evolution, describe the pattern of data that it predicts/explains • Explain what Darwin meant by 'common descent' • Use homologous structures to establish a degree of relation between two or more species • Explain the difference between fitness and an adaptation • Describe the difference between derived traits and ancestral traits	April- May (3 weeks)

		• Compare/contrast homologous structures with analogous structures • Describe how adaptations allow an organism to survive • Describe the 3 patterns and 3 processes of evolution • When given a specific scenario, identify the type of natural selection that is occurring or is most likely to occur in the future • Compare gradualism with punctuated equilibrium • Summarize a general process by which one species can evolve into two species • Compare/contrast allopatric speciation with sympatric speciation • Define speciation and describe the factors that influence speciation •	
31, 32, 33, 34, 35, 66, 67, 68, 69, 70	3.1.B.A2 Eligible Content: BIO.B.4.1.1; BIO.B.4.1.2; BIO.B.4.2.1; BIO.B.4.2.2; BIO.B.4.2.3 BIO.B.4.2.4; BIO.B.4.2.5	• Define ecology • Differentiate between biotic and abiotic factors in an environment and give examples of each • Identify and define the levels of biological organization • Differentiate between an organisms habitat and its niche • Differentiate between the fundamental niche and the realized niche of an organism • Explain the principle of competitive exclusion • Define symbiosis • Identify three forms of symbiosis and describe the relationship that exists in each form • Describe the flow of energy from primary producers to consumers to decomposers • When given a food chain/web, identify an organism's niche • Identify the ultimate energy source for photosynthetic producers • Describe food chains, food webs, and pyramid models • Describe the rule of 10% and explain how it limits the number of levels in an energy pyramid • Describe the feeding relationships in a food web • Describe how nutrients are recycled among organisms and ecosystems in the biosphere • Explain the importance of nutrients to living organisms • Compare the biogeochemical cycles of nutrients. For each cycle identify the	May (2 weeks)

		biological/usable forms of the nutrient, the non-biological/non-usable forms of the nutrient, any/all processes that convert the usable form into a non-usable form, and all processes that convert the non-usable form into a usable form. • Describe how human activity can affect the biogeochemical cycles • Define ecological succession and describe the changes that occur as a community goes through the stages of succession, including types of organisms that are found at each stage • Describe pioneer species and climax communities and their role in succession • Define biodiversity • Identify the characteristics that are used to define a biome • Describe the major features of several major terrestrial and aquatic biomes • Describe characteristics of a population • Identify all the ways that individuals can be added or removed from a population • Define limiting factor and describe its effect on a population • Describe the difference between a density-dependent limiting factor and a density-independent limiting factor and recognize examples of each • Define carrying capacity • Describe the difference between exponential and logistic growth • When given a graph of population growth, correctly identify different growth patterns	