Grade/Course:
Biology – Introduction to Biology Unit (5% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.A.1.1.1
BIO.A.1.2.1
BIO.A.1.2.2

Pennsylvania Core Standards:
Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit examines the nature of life, the common characteristics of living things, and the relationship between structure and function from the organelle to the multicellular organism.

Essential Questions:	**Understandings: Students will understand THAT . . .**
How do we know if something is alive? How is structure related to function at the various levels of cellular organization?	• Common characteristics of life: o Composed of one or more units called cells o Obtain and use matter and energy to carry out their life processes o Reproduce and pass their genetic material on to the next generation o Maintain homeostasis o Grow, develop and eventually die o Detect and respond to stimuli o Adapt and evolve at the population level

	• Similarities and differences in structure between prokaryotic and eukaryotic cells
	• Common features/functions of cell structures in both prokaryotic and eukaryotic cells
	• Relationship between form and function
	• Levels of biological organization from organelle to multicellular organism
	  o Organelle
	  o Cell
	  o Tissue
	  o Organ
	  o Organ System
	  o Multicellular Organism

Knowledge: Adapt Cell Eukaryotic Evolve Multicellular organism Organ Organ system Organelle Population Prokaryotic Stimuli Tissue Unicellular	**Skills:** • Describe the common characteristics exhibited by all living things – both prokaryotic and eukaryotic. • Compare cellular structures and their functions in prokaryotic and eukaryotic cells. • Describe and interpret relationships between structure and function at the organelle, cell, tissue, organ, organ system and multicellular organism level of organization.

Grade/Course:
Biology – Chemical Basis of Life Unit (12% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.A.2.1.1
BIO.A.2.2.1
BIO.A.2.2.2
BIO.A.2.2.3
BIO.A.2.3.1
BIO.A.2.3.2

Pennsylvania Core Standards:
Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit includes the emergent properties of water and organic compounds and how they are essential for life on earth.

Essential Questions:	**Understandings: Students will understand THAT . . .**

How is life a product of the organization and interaction of matter?	• Chemical structure of water
	• Polarity of water/hydrogen bonding and related properties
	  o Adhesion and cohesion
	  ▪ Surface tension
	  ▪ Capillary action
	  o High specific heat

	○ Versatile solvent ○ Density of ice • Examples of how the properties of water make life on earth on possible ○ Temperature moderation ○ Solid water less dense than liquid water ○ Water cycle ○ Metabolism requires an aqueous environment ○ Transpiration ○ Buffering properties of water • Levels of biochemical organization (atoms, molecules, macromolecules) • Chemical properties of carbon atoms ○ Form 4 covalent bonds • Structural shapes of carbon molecules (straight chains, branched chains, rings) • Monomers vs. polymers • Monomer that forms carbohydrates, proteins and nucleic acids (monosaccharide, amino acid, nucleotide) ○ Idea of no common monomer for lipids • Dehydration synthesis (condensation) and hydrolysis reactions • Basic structure of the four major classes of biological macromolecules ○ Common chemical components ○ Examples of monomers from each class ○ Examples of polymers constructed of the monomers • Importance and use of each macromolecule for biological functions • Enzymes as proteins • Enzyme and substrate specificity/interactions ○ Lock and key model ○ Induced fit • Effect of enzymes on activation energy and reaction rates • Reusable nature of enzymes • Examples of enzyme controlled reactions in living things • Enzyme activity as a function of specific conditions • Effects of environmental factors (pH, temperature, concentration) on enzyme function
Knowledge: Activation energy Active site	**Skills:** • Describe the unique properties of water. • Explain how the unique properties of water make life on earth possible.

Adhesion Allosteric Amino acid Buffer Capillary action Carbohydrates Catalyst Cohesion Competitive inhibitor Concentration Dehydration synthesis (condensation) Enzyme Evaporative cooling Hydrogen bond Hydrolysis Induced fit Lipids Macromolecule Monomer Monosaccharide Noncompetitive inhibitor Nucleic acids Nucleotide pH Polarity polymer properties (scientific) proteins reaction rates specific heat substrate surface tension transpiration versatile solvent	• Describe the structure of a carbon atom. • Explain how carbon atoms bond to form biological macromolecules. • Describe how biological macromolecules form from monomers. • Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms. • Explain how enzymes act as catalysts to regulate biochemical reactions. • Explain how environmental factors affect the function and reaction rate of the enzyme. • Interpret graphs to analyze enzyme-catalyzed reactions.

Grade/Course:
Biology – Bioenergetics Unit (10% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.A.3.1.1.
BIO.A.3.2.1
BIO.A.3.2.2

Pennsylvania Core Standards:

Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit examines the basic processes of photosynthesis and cellular respiration and the associated cell structures.

Essential Questions:	**Understandings: Students will understand THAT . . .**
How do organisms obtain and use energy to carry out their life processes?	• Double membrane structure of mitochondria and chloroplasts • Roles of mitochondria and chloroplasts in energy transformations • Catabolic vs. anabolic chemical reactions as related to metabolism • Overall (summary) chemical equations for photosynthesis and cellular respiration • Basic energy transformations during photosynthesis and cellular respiration • Relationship between photosynthesis and cellular respiration • Molecular structure of ATP • ATP-ADP cycle • Importance of ATP as the energy currency (fuel) for cell processes

Knowledge:	**Skills:**
adenosine triphosphate (ADP) adenosine triphosphate (ATP) anabolic reaction catabolic reaction cellular respiration chemical energy electromagnetic energy chloroplasts energy transformation metabolism mitochondria photosynthesis plastids	• Describe the structure of mitochondria and chloroplasts in eukaryotic cells. • Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations. • Compare the **basic** transformations of energy during photosynthesis and cellular respiration. • Describe the structure of ATP. • Describe the role of ATP in biochemical reactions.

Grade/Course:
Biology – Homeostasis and Transport (8% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.A.4.1.1
BIO.A.4.1.2
BIO.A.4.1.3
BIO.A.4.2.1

Pennsylvania Core Standards:

Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit examines the structures and mechanisms involved in the transport of materials across membranes and resulting effects on homeostasis in living things

Essential Questions:	**Understandings: Students will understand THAT . . .**

How do organisms maintain a biological balance between their internal and external environments?	• Chemical structure of the plasma membrane (Phospholipid bilayer)
	• Fluid mosaic model
	• Functions of the plasma membrane
	• Passive transport mechanisms
	  o Diffusion
	  o Osmosis
	  o Facilitated diffusion

	• Active transport mechanisms
	  o Pumps
	  o Endocytosis
	  o Exocytosis
	• Endoplasmic reticulum
	  o Rough ER
	  ▪ Synthesis/transport of proteins
	  o Smooth ER
	  ▪ Synthesis/transport of lipids
	  ▪ Synthesis/transport of carbohydrates
	• Golgi apparatus -- processes and packages for intra and extra-cellular transport
	• Examples of Mechanisms
	  o Thermoregulation
	  o Water regulation
	  o Oxygen regulation
	  o Chemical regulation
	  ▪ pH/Buffers
	  ▪ Hormone
	  ▪ Electrolyte

Knowledge: active transport carrier/transport protein concentration gradient diffusion endocytosis endoplasmic reticulum equilibrium exocytosis facilitated diffusion fluid mosaic model Golgi apparatus homeostasis intracellular transport osmosis passive transport	**Skills:** • Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell. • Compare and contrast active vs. passive transport mechanisms. • Describe how membrane-bound cellular organelles facilitate intracellular transport of materials. • Explain mechanisms organism use to maintain homeostasis.

phospholipid bilayer plasma membrane pumps selectively/semi- permeable vesicles	

Grade/Course:
Biology – DNA, RNA, and Protein Synthesis Unit (10% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.B.1.2.1
BIO.B.1.2.2
BIO.B.2.2.1
BIO.B.2.2.2
BIO.B.2.3.1

Pennsylvania Core Standards:

Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit examines the role of nucleic acids and cellular organelles in the production of proteins and the resultant expression of phenotype.

Essential Questions:	**Understandings: Students will understand THAT . . .**

How do organisms use DNA and RNA to make proteins? What factors affect gene expression?	• Structure of DNA
	  o Components of a nucleotide
	  o Base-pair rule (Chargaff's Rule)
	• Semi-conservative/DNA replication process
	• Structure of eukaryotic chromosomes
	• Similarities and differences between DNA and RNA
	• Types of RNA
	• Transcription uses DNA to make RNA

	• Translation uses RNA to make a protein • Role of ribosomes, endoplasmic reticulum and Golgi apparatus in assembling, transporting, packaging and modifying different proteins • Phenotype as a function of gene expression (DNA to protein to phenotype) • Different types of gene mutations • Possible effect of mutation (change in the DNA sequence) on phenotype • Environmental influences on phenotype
Knowledge: adenine amino acids anticodon Chargaff's Rule chromosomes codon complimentary strand cytosine deletion deoxyribonucleic acid (DNA) Deoxyribose DNA replication double helix endoplasmic reticulum enzymes frame shift mutation gene mutation genes Golgi apparatus guanine hydrogen bond insertion missense nonsense nucleotide nucleus parent strand phenotype	**Skills:** • Describe how DNA replication results in the transmission and/or conservation of the genetic information. • Explain the structural relationships between DNA, genes, and chromosomes. • Explain the unified process of protein synthesis. • Describe the role of the nucleus, ribosomes, ER, and Golgi apparatus in the production and processing of proteins. • Describe how genetic mutations alter DNA sequence and may or may not affect phenotype.

phosphate group point mutation polypeptides proteins ribonucleic acid (RNA) ribosomes semi-conservative model silent thymine transcription translation triplet uracil	

Grade/Course:
Biology – Cell Growth and Reproduction Unit (10% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.B.1.1.1
BIO.B.1.1.2
BIO.B.2.1.2

Pennsylvania Core Standards:
Reading
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas
This unit examines the processes of mitosis and meiosis and their roles in growth and reproduction.

Essential Questions:	**Understandings: Students will understand THAT . . .**

How do new cells arise from the division of pre-existing cells?	• Cell cycle in a non-reproductive, eukaryotic cell
	  o Interphase
	  ▪ G1
	  ▪ S
	  ▪ G2
	  o Nuclear division
	  ▪ Mitosis
	  o Cytokinesis
	  ▪ Plant vs. animal cell

	• Phases of mitosis: prophase, metaphase, anaphase, telophase • Phases of meiosis in diploid, germ-line stem cells • Importance of mitosis and meiosis • Outcomes of mitosis and meiosis • Importance of chromosome composition and number in controlling phenotype
Knowledge: anaphase asexual cell cycle cell plate centrioles chromatin chromatid chromosomal mutation chromosome cleavage furrow crossing over cytokinesis daughter cells deletion diploid duplication gametes germ-line cells haploid homologous chromosomes independent assortment insertion interphase inversion meiosis	**Skills:** • Describe the events that occur during the cell cycle. • Compare and contrast the processes and outcomes of mitotic and meiotic nuclear divisions. • Describe processes that can alter composition or number of chromosomes (chromosomal mutations).

metaphase mitosis nondisjunction prophase sexual somatic cells spindle (fiber) telophase tetrad translocation	

Grade/Course:
Biology – Patterns of Inheritance (10% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.B.1.2.2
BIO.B.2.1.1

Pennsylvania Core Standards:
Reading
CC.3.5.9-10.A
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G
CC.3.5.9-10.H
CC.3.5.9-10.I

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.G
CC.3.6.9-10.H

Big Ideas: This unit examines the functional relationships between DNA, genes, alleles and chromosomes and how observed patterns of inheritance and mathematical probability can be used to predict genotypes and phenotypes.

Essential Questions:	**Understandings: Students will understand THAT . . .**

How can observed patterns of inheritance be used to predict genotypes and phenotypes of offspring?	• Common patterns of inheritance
	• Tools for predicting patterns of inheritance
	  o Punnett square
	  o Pedigree
	  o Mathematics of probability

	• Relationship between genotype and phenotype
Knowledge: alleles chromosomes Codominance dominant DNA genes genetics genotype heterozygous/hybrid homozygous/pure incomplete dominance multiple alleles pedigree phenoytpe polygenic probability Punnett square recessive sex-linked testcross	**Skills:** • Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance. • Describe and/or predict observed patterns of inheritance.

Grade/Course:
Biology – Biotechnologies (5% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.B.2.4.1

Pennsylvania Core Standards:

Reading
CC.3.5.9-10.A
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.H

Big Ideas: This unit explores various tools and applications of biotechnology that impact the fields of medicine, forensics and agriculture.

Essential Questions: How do biotechnologies impact the fields of medicine, forensics and agriculture?	**Understandings: Students will understand THAT . . .**
	• Tools of genetic engineering
	  o Gel electrophoresis
	  o PCR
	  o Restriction enzymes
	  o Bacterial and viral plasmids
	  o Recombinant DNA
	  o Gene splicing
	  o Selective breeding
	  o Cloning
	  o DNA Sequencing
	• Applications of genetic engineering

	○ DNA fingerprinting ○ Genetically modified organisms in medicine and agriculture ○ Gene Therapy ○ Stem cell therapy ○ Human Genome Project
Knowledge: biotechnology cloning DNA fingerprinting DNA sequencing electrophoresis gene splicing gene therapy genetic engineering genetically modified organisms (GMO) plasmids polymerase chain reaction (PCR) recombinant DNA restriction enzymes selective breeding stem cell transgenic organism	**Skills:** • Describe tools used in genetic engineering. • Describe applications of genetic engineering. • Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.

Grade/Course:
Biology – Theory of Evolution (10% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
BIO.B.3.1.1
BIO.B.3.1.2
BIO.B.3.1.3
BIO.B.3.2.1
BIO.B.3.3.1

Pennsylvania Core Standards:
Reading
CC.3.5.9-10.A
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G
CC.3.5.9-10.H

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.G
CC.3.6.9-10.H

Big Ideas
This unit examines the natural processes described by the theory of evolution.

Essential Questions:	**Understandings: Students will understand THAT . . .**
How do natural processes as described by the theory of evolution effect change in a population over time?	• Principles of inheritance as they relate to evolution • Fundamental principles of natural selection • Types of natural selection

	○ Directional ○ Stabilizing ○ Diversifying/disruptive • Factors that contribute to speciation ○ Isolating mechanisms ○ Genetic drift ○ Founder effect ○ Migration • Types of genetic mutations and their impact on genotype and phenotype • Examples of variation in populations • Evidences of evolution ○ Fossil ○ Anatomical ○ Physiological ○ Embryological ○ Biochemical ○ Universal Genetic Code • Scientific terms ○ Hypothesis and prediction ○ Inference and observation ○ Principle ○ Theory ○ Law • Fact and opinion
Knowledge: adaptation allele frequency analogous structures anatomical behavioral isolation biochemical convergent evolution directional selection divergent evolution diversifying/ disruptive selection embryological	**Skills:** • Explain how natural selection can impact allele frequencies of a population. • Describe the factors that can contribute to the development of a new species. • Explain how genetic mutations may result in genotypic and phenotypic variations within a population. • Interpret evidence supporting the theory of evolution. • Use scientific terms properly in written and oral form.

evolution fact fitness fossil fossil record founder effect genetic drift genotype geographic isolation homologous structures hypothesis inference isolating mechanisms law migration mutation natural selection observation opinion phenotype physiological populations prediction principle reproductive isolation speciation species stabilizing selection temporal isolation theory universal genetic code variation vestigial structures	

Grade/Course:
Biology – Ecology (20% of Course Time Prior to Keystone Exam)
Grade 10

Subject Specific Standards:
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

Pennsylvania Core Standards:

Reading
CC.3.5.9-10.A
CC.3.5.9-10.B
CC.3.5.9-10.C
CC.3.5.9-10.D
CC.3.5.9-10.E
CC.3.5.9-10.G

Writing
CC.3.6.9-10.B
CC.3.6.9-10.C
CC.3.6.9-10.E
CC.3.6.9-10.F
CC.3.6.9-10.G
CC.3.6.9-10.H

Big Ideas
This unit examines the interactions of organisms with one another and their interrelationship with the environment.

Essential Questions:	**Understandings: Students will understand THAT . . .**
How do organisms interact with and depend on each other in an ecosystem? How are organisms impacted by the nonliving	• The levels of ecological organization o Organism o Population

components of an ecosystem?	○ Community ○ Ecosystem ○ Biome ○ Biosphere • Abiotic components of an ecosystem • Biotic components of an ecosystem • Characteristic abiotic and biotic components of earth's aquatic and terrestrial ecosystems. • The ultimate energy source is the sun. ○ Other initial sources of energy ▪ Chemicals ▪ Heat • Photosynthesis and cellular respiration • Structure and components of a food chain or food web. • Implications of the 10% rule/law (energy pyramids) • Habitat and niche (fundamental and realized) • Symbiotic interactions within an ecosystem ▪ Biogeochemical cycles ○ Water cycle ○ Carbon cycle ○ Oxygen cycle ○ Nitrogen cycle ▪ Examples of natural disturbances affecting ecosystems ○ Ecological succession ○ Natural disasters ▪ Examples of human disturbances affecting ecosystems ○ Human overpopulation ○ Climate changes ○ Introduction of nonnative species ○ Pollution ○ Fires ▪ Effects of human and natural disturbances on ecosystems ○ Loss of biodiversity ○ Loss of habitat ○ Increased rate of extinction ○ Disruption of natural biological cycles

	• Carrying capacity
	• Limiting factors
	  o Density dependent
	  o Density independent
	• Effects of limiting factors on population dynamics
	  o Biotic potential
	  o Environmental resistance
	  o Increase/decreased/ stabilized population growth
	  o Extinction
	  o Increased/decreased/stabilized biodiversity

Knowledge: 10% rule/law abiotic aquatic ecosystem autotroph biodiversity biome biosphere biotic biotic potential carbon cycle carnivore carrying capacity chemosynthesis commensalism community competition consumer decomposer density dependent density independent ecological pyramid ecosystem energy evolution	**Skills:** ▪ Describe and differentiate between the levels of ecological organization. ▪ Describe characteristic biotic and abiotic components of terrestrial and aquatic ecosystems. ▪ Describe how energy **flows through** an ecosystem. • Describe biotic interactions within an ecosystem. ▪ Describe the niche of an organism. ▪ Describe how matter **recycles in** an ecosystem. ▪ Describe how ecosystems change in response to natural and human disturbances. ▪ Describe the effects of limiting factors on population dynamics and potential species extinction.

extinction food chain food web fundamental niche herbivore heterotroph limiting factors mutualism nitrogen cycle nonnative species omnivore organism oxygen cycle parasitism photosynthesis population predation producer realized niche succession symbiosis terrestrial ecosystem trophic level water cycle	