Pequea Valley School District
Science

Unit 1: Basics of Biology **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How do we know if something is living?

Keystone Eligible Content/PA Core Standard
BIO.A.1.1.1 - Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
BIO.A.1.2.2 - Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Pacing: Approximate number of class sessions per unit
- 4

Tier 3 Vocabulary (Content specific vocabulary)
- biology
- cell
- reproduction
- metabolism
- stimuli
- homeostasis
- homeostatic mechanism
- organ
- organ system
- organism
- science
- system
- eukaryote
- prokaryote
- atom

- molecule
- organelle
- population
- community
- ecosystem
- biome
- Biosphere

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- What characterizes an organism
- How to explain each characteristic of life
- How to organize life into a hierarchy based on complexity

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Living things are defined by a set of characteristics.
- Living things are organized systems.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

The learners will be able to:

- Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
- Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms).

Software:

Resources:

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Unit 2: Ecology **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How do biotic and abiotic factors play a role in the structure of the ecosystem?
- What are the effects of limiting factors on population dynamics and potential species extinction?
- How do species interact within a community?
- How does the structure of an ecosystem determine how energy flows through it?
- How does matter cycle through an ecosystem?
- How do ecosystems change in response to natural and human disturbances?

Keystone Eligible Content/PA Core Standard
- **BIO.B.4.1.1** Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).
- **BIO.B.4.1.2** Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.
- **BIO.B.4.2.1** Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).
- **BIO.B.4.2.2** Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).
- **BIO.B.4.2.3** Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle).
- **BIO.B.4.2.4** Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).
- **BIO.B.4.2.5** Describe the effects of limiting factors on population dynamics and potential species extinction.

Pacing: Approximate number of class sessions per unit
- 40

Tier 3 Vocabulary (Content specific vocabulary)
- biosphere
- biome
- ecosystem
- biotic
- abiotic
- agriculture
- aquatic

- biochemical conversion
- bioenergetics
- trophic level
- decomposer
- biogeochemical cycles
- food chain
- food web
- ecological community
- ecological consumer
- ecology
- endemic species
- energy pyramid
- energy transformation
- environment
- limiting factor
- nonnative species
- population
- ecological producer
- species
- succession
- symbiotic relationship
- terrestrial
- habitat

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- How to decipher between a biotic and an abiotic factor in an ecosystem
- Analyze how to limiting factors impact populations and their growth and decline
- Explain how species interact with one another in a community
- How energy flows within an ecosystem
- How to connect how cycles move matter through an ecosystem.
- How natural and human disturbances impact ecosystems over time

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Biological systems interact, and these systems and their interactions possess complex properties.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).
- Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.
- Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).
- Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).
- Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle).
- Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).
- Describe the effects of limiting factors on population dynamics and potential species extinction.

Software:

Resources:

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Unit 3: Chemical Basis of Life **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How do atoms bond together to form molecules?
- How is carbon uniquely suited to form biological macromolecules?
- How do the unique properties of water support life on Earth?
- How does the structure fit the function of biomacromolecules like carbohydrates, lipids, proteins and nucleic acids?
- What is the role of an enzyme as a catalyst in regulating a specific biochemical reaction?
- How do factors such as pH, temperature, and concentration levels affect enzyme function?

Keystone Eligible Content/PA Core Standard
- **BIO.A.2.2.1** Explain how carbon is uniquely suited to form biological macromolecules.
- **BIO.A.2.2.2** Describe how biological macromolecules form from monomers.
- **BIO.A.2.2.3** Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.
- **BIO.A.2.3.1** Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- **BIO.A.2.3.2** Explain how factors such as pH, temperature, and concentration levels can affect enzyme function

Pacing: Approximate number of class sessions per unit
- 26

Tier 3 Vocabulary (Content specific vocabulary)
- atom
- ionic bond
- covalent bond
- hydrogen bond
- adhesion
- cohesion
- specific heat
- concentration
- freezing point

- universal solvent
- surface tension
- capillary action
- pH
- acid
- base
- monomer
- polymer
- dehydration synthesis
- hydrolysis
- biological macromolecules
- molecule
- organic molecule
- macromolecule
- carbohydrate
- amino acid
- protein
- lipid
- nucleic acid
- enzyme
- catalyst
- active site
- substrate
- denature

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- An atom's structure and how atoms form bonds
- How to apply the properties of water to biological organisms.
- How to analyze the effect of pH changes on living organisms.
- How polymers are made from monomers through chemical reactions
- How to compare the 4 major classes of biomolecules as well as their functions
- How enzymes are essential in various chemical reactions and what factors can influence the rate at which an enzyme works.

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

The learners will be able to:

- Explain how carbon is uniquely suited 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.
- Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- Explain how factors such as pH, temperature, and concentration levels can affect enzyme function

Software:

Resources:

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Unit 4: Homeostasis and Transport **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How does the cell theory help us to understand living things?
- How does the surface area to volume ratio of a cell determine its size limit?
- How do the forms of a cell's organelles relate to their various functions?
- How does the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell?
- How do passive and active transport transport material across the cell membrane?

Keystone Eligible Content/PA Core Standard
BIO.A.1.2.1 - Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
BIO.B.2.2.2 - Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.
BIO.A.4.1.2 - Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).
BIO.A.3.2.2 - Describe the role of ATP in biochemical reactions.
BIO.A.4.1.3 - Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.
BIO.A.4.2.1 - Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation)

Pacing: Approximate number of class sessions per unit
- 28

Tier 3 Vocabulary (Content specific vocabulary)
- cell
- cell theory
- surface area/volume
- cell membrane
- nucleus
- ribosome
- mitochondria
- chloroplast
- active transport

- carrier (transport) proteins
- concentration gradient
- diffusion
- endocytosis
- endoplasmic reticulum
- endosymbiosis
- exocytosis
- facilitated diffusion
- extracellular
- Golgi apparatus
- impermeable
- intracellular
- organelle
- osmosis
- passive transport
- plastids
- pumps (ion or molecular)
- unicellular
- multicellular

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- Why the surface area to volume is important for living cells
- How to differentiate between a prokaryotic and eukaryotic cell
- How cell organelles work together to make a functioning cell
- The structure and function of a cell membrane
- What passive transport is and what the different types are
- What active transport is and what the different types are
- How to compare and contrast passive and active transport

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
- Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.

- Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).
- Describe the role of ATP in biochemical reactions.
- Describe how membrane‐bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.
- Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation)

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Unit 5: Bioenergetics **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How is energy transformed during photosynthesis?
- How is energy transformed during cellular respiration?
- How can you compare photosynthesis to cellular respiration?

Keystone Eligible Content/PA Core Standard
BIO.A.3.1.1 - Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.
BIO.A.3.2.1 - Compare the basic transformation of energy during photosynthesis and cellular respiration.
BIO.A.3.2.2 - Describe the role of ATP in biochemical reactions.

Pacing: Approximate number of class sessions per unit
- 12

Tier 3 Vocabulary (Content specific vocabulary)
- photosynthesis
- cellular respiration
- electron transport chain
- ATP
- glucose
- light-dependent reactions
- light-independent reactions
- mitochondria
- chloroplast
- thylakoids
- catabolism
- anabolism
- aerobic
- anaerobic
- fermentation
- autotroph

- heterotroph
- Metabolism

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- The structure and function of ATP
- The inputs and outputs of photosynthesis
- The inputs and outputs of cellular respiration
- How photosynthesis and cellular respiration are connected

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.
- Compare the basic transformation of energy during photosynthesis and cellular respiration.
- Describe the role of ATP in biochemical reactions.

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Unit 6: Cell Growth and Reproduction **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How do the processes and outcomes of mitotic and meiotic nuclear divisions compare?

Keystone Eligible Content/PA Core Standard
BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.
BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

Pacing: Approximate number of class sessions per unit
- 6

Tier 3 Vocabulary (Content specific vocabulary)
- allele
- cell cycle
- chromosomes
- crossing over
- cytokinesis
- DNA replication
- gamete
- gene
- interphase
- meiosis
- mitosis
- nondisjunction
- semiconservative replication

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- The events of the cell cycle
- The phases of mitosis
- The phases of meiosis
- How mitosis and meiosis are similar yet different in their outcome
- The structure and function of DNA
- How a DNA, a gene, an allele and a chromosome are all connected

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Living systems store, retrieve, transmit and respond to information essential to life processes.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
- Compare the processes and outcomes of mitotic and meiotic nuclear divisions.
- Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

Software:

Resources:

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Unit 7: DNA and Protein Synthesis **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How does the process of DNA replication result in the transmission and/or conservation of genetic information?
- How are the processes of transcription and translation similar in all organisms?
- How do genetic mutations alter the DNA sequence and may or may not affect phenotype?

Keystone Eligible Content/PA Core Standard
BIO.B.1.2.1 - Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
BIO.B.2.2.1 - Describe how the processes of transcription and translation are similar in all organisms.
BIO.B.2.3.1 - Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame‑shift).
BIO.B.2.2.2 - Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.

Pacing: Approximate number of class sessions per unit
- 11

Tier 3 Vocabulary (Content specific vocabulary)
- chromosomes
- DNA replication
- frame-shift mutation
- gene
- gene expression
- gene recombination
- mutation
- point mutation
- semiconservative replication
- transcription
- translation

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- The structure of DNA
- The process of DNA replication
- The process of transcription
- The process of translation
- The various types of genetic mutations
- The functions of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Living systems store, retrieve, transmit and respond to information essential to life processes.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
- Describe how the processes of transcription and translation are similar in all organisms.
- Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame‐shift).
- Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.

Software:

Resources:

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Unit 8: Genetics **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How can we predict observed patterns of inheritance?
- How has genetic engineering impacted the fields of medicine, forensics, and agriculture?

Keystone Eligible Content/PA Core Standard
BIO.B.2.1.1 - Describe and/or predict observed patterns of inheritance (ie. dominant, recessive, codominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).
BIO.B.2.1.2 - Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).
BIO.B.2.4.1 - Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).

Pacing: Approximate number of class sessions per unit
- 18

Tier 3 Vocabulary (Content specific vocabulary)
- cloning
- codominance
- dominant inheritance
- gene splicing
- gene therapy
- gene recombination
- genetic engineering
- genetics
- incomplete dominance
- inheritance
- multiple alleles
- polygenic trait

- transcription
- translation
- translocation
- chromosomal mutation
- deoxyribonucleic acid
- frameshift mutation
- gene expression
- mutation
- point mutation
- recessive inheritance
- sex-linked trait
- genetically modified organism
- genotype
- phenotype

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- How to complete Punnett squares
- How to represent each of the patterns of inheritance on a Punnett square
- The process that can alter composition or number of chromosomes
- How disruptions to genes or gene expression can cause disease
- The different methods of genetic engineering
- The different applications of genetic engineering

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Living systems store, retrieve, transmit and respond to information essential to life processes.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Describe and/or predict observed patterns of inheritance (ie. dominant, recessive, codominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).
- Describe processes that can alter composition or number of chromosomes (i.e., crossing‑over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).
- Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).

Software:

Resources:

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Unit 9: Evolution **Course: Biology** **Grade: 10-11**

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):
- How can natural selection impact allele frequencies of a population?
- How do we interpret the evidence supporting the theory of evolution?

Keystone Eligible Content/PA Core Standard
BIO.B.3.3.1 - Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.
BIO.B.3.1.1 - Explain how natural selection can impact allele frequencies of a population.
BIO.B.3.1.2 - Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).
BIO.B.3.1.3 - Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
BIO.B.3.2.1 - Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).

Pacing: Approximate number of class sessions per unit
- 10

Tier 3 Vocabulary (Content specific vocabulary)
- allele frequency
- analogous structure
- embryology
- evolution
- fossils
- founder effect
- genetic drift
- gradualism
- homologous structure
- isolating mechanisms
- migration

- natural selection
- punctuated equilibrium
- speciation
- vestigial structure

Know - What do learners need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

The learners will know:

- Definitions for hypothesis, inference, law, theory, principle, fact, and observation
- Natural selection as a mechanism for evolution
- How allele frequencies can change within a population
- The 5 factors that can spur evolution within a population
- The factors that contribute to new species

Understand - What do learners need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- The process of evolution drives the diversity and unity of life.

Learning Outcome - What do learners need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.
- Explain how natural selection can impact allele frequencies of a population.
- Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration).
- Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
- Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).

Software:

Resources: