



# Biology Curriculum Guide for High School SDP Science Teachers



Please note: Pennsylvania & Next Generation Science Standards as well as Instructional Resources are found on the SDP Curriculum Engine

## **Biology: Term 1 Unit 1**

**Topic:** Basic Biological Principles

**Duration:** Traditional (50 minute periods): 11-15 classes (adjust using professional discretion)

Block (90 minute periods): 6-8 classes (adjust using professional discretion)

### **Eligible Content**

**BIO.A.1.1.1** Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.

**BIO.A.1.2.1** Compare cellular structures and their functions in prokaryotic and eukaryotic cells.

**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).

### **Performance Objectives**

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** define and recognize examples of the characteristics of living things **IOT** discuss whether particular examples (e.g. bacterium, virus, computer) are living or non-living.
- **SWBAT** compare and contrast prokaryotic and eukaryotic cells **IOT** describe their degrees of complexity.
- **SWBAT** compare and contrast a typical plant cell with a typical animal cell **IOT** hypothesize reasons for structural differences.
- **SWBAT** create an analogy for the function of each of the organelles found in a eukaryotic cell **IOT** reinforce organelle function.
- **SWBAT** analyze examples in human physiology **IOT** describe relationships between structure and function at biological levels of organization.

### **Key Terms and Definitions**

1. **Biology:** The scientific study of life.
2. **Cell:** The basic unit of structure and function for all living organisms. Cells have three common components: genetic material, cytoplasm, and a cell membrane. Eukaryotic cells contain specialized organelles - prokaryotes do not.
3. **Eukaryote:** A type of organism composed of one or more cells that contain a membrane-bound nucleus and specialized organelles.
4. **Multicellular:** Organisms that are made up of more than one cell.
5. **Nucleus:** A membrane-bound organelle in eukaryotic cells functioning to protect the genetic material.
6. **Organ:** An anatomical unit composed of tissues serving a common function.

7. **Organ System:** An anatomical system composed of a group of organs that work together to perform a specific function or task.
8. **Organelle:** A subunit within a cell that has a specialized function.
9. **Organism:** A form of life; an animal, plant, fungus, protist or bacterium.
10. **Plasma Membrane:** A thin, phospholipid and protein molecule bilayer that encapsulates a cell and controls the movement of materials in and out of the cell through active or passive transport
11. **Prokaryote:** A single-celled organism that lacks a membrane-bound nucleus and specialized organelles.
12. **Ribosome:** A cellular structure composed of RNA and proteins that is the site of protein synthesis in eukaryotic and prokaryotic cells.
13. **Tissue:** An anatomical unit composed of cells organized to perform a similar function.
14. **Unicellular:** Organisms that are made up of one cell.

### **Biology: Term 1 Unit 2**

**Topic:** The Chemical Basis for Life

**Duration:** Traditional (50 minute periods): 25-29 classes (adjust using professional discretion)  
 Block (90 minute periods): 11-14 classes (adjust using professional discretion)

#### **Eligible Content**

**BIO.A.2.1.1** Describe the unique properties of water and how these properties support life on Earth (e.g. freezing point, high specific heat, cohesion)

**BIO.A.2.2.1** Explain how carbon is uniquely suited to form biological macromolecules.

**BIO A.2.2.2** Explain 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.

#### **Performance Objectives**

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** describe the unique properties of water **IOT** explain its role in sustaining life on earth.
- **SWBAT** Identify and describe the parts of an atom **IOT** differentiate between elements.

- **SWBAT** describe the structure of a carbon atom and how carbon atoms form macromolecules **IOT** assess its function.
- **SWBAT** differentiate between ionic and covalent bonding **IOT** explain compound formation and compound properties.
- **SWBAT** describe dehydration synthesis and hydrolysis reactions **IOT** explain the relationship between macromolecules and monomers.
- **SWBAT** compare the structure and function of carbohydrates, lipids, proteins and nucleic acids in organisms **IOT** assess their functions.
- **SWBAT** describe the role of enzymes as catalysts **IOT** understand their function in the rate of chemical reactions.
- **SWBAT** explain how factors such as pH, temperature, and concentration levels can affect enzyme function **IOT** analyze a chemical reaction.

### Key Terms and Definitions

1. **Adhesion:** The attraction between unlike molecules. Capillary action results from the adhesive properties of water and the molecules that make up plant cells.
2. **Atom:** The smallest unit of an element that retains the chemical properties of that element
3. **Carbohydrate:** A macromolecule that contains atoms of C, H, and O in a 1:2:1 ratio and serves as a major source of energy for living organisms (e.g. sugars, starches, and cellulose)
4. **Catalyst:** A substance that enables a chemical reaction to proceed at a usually faster rate or under different conditions (e.g., lower temperature) than otherwise possible without being changed by the reaction.
5. **Cohesion:** The attraction between like molecules. Surface tension results from the cohesive properties of water.
6. **Concentration:** The measure of the amount or proportion of a given substance when combined with another substance
7. **Enzyme:** A protein that increases the rate of a chemical reaction without being changed by the reaction
8. **Lipid:** A macromolecule composed of hydrocarbon chains; they generally contain C and H in a 1:2 ratio and a small amount of O. They are a major source of energy for living organisms (e.g. fat).
9. **Macromolecule:** A polymer with a high molecular mass. Within organisms there are four main groups: carbohydrates, nucleic acids, lipids, and proteins.
10. **Molecule:** The smallest particle of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms held together by chemical forces (covalent bonds).

11. **Monomer:** A molecule of any compound that can react with other molecules of the same or different compound to form a polymer. Each biological macromolecule has characteristic monomers.
12. **Nucleic Acid:** A biological macromolecule (DNA or RNA) composed of the elements C, H, N, O, and P that carries genetic information.
13. **Organic molecule:** A molecule containing carbon that is a part of or produced by living systems.
14. **pH:** The measure of acidity or alkalinity (basicity) of an aqueous solution scaling from 1 (highly acidic) to 14 (highly alkaline) with a midpoint of 7 (neutral)
15. **Protein:** A macromolecule that contains C, H, O, N and sometimes P and S; performs a variety of structural and regulatory functions for cells.
16. **Specific heat:** The amount of energy required to change the temperature or phase of a substance. The high specific heat of water explains its use in evaporative cooling and its suitability as a habitat.

### **Biology: Term 2 Unit 3**

**Topic:** Bioenergetics

**Duration:** Traditional (50 minute periods): 13 - 18 days (adjust to student needs using professional discretion)  
Block Schedule (90 minute periods): 6 - 8 days (adjust to student needs using professional discretion)

#### **Eligible Content**

**BIO.A.3.1.1** Describe the fundamental role of plastids (e.g. chloroplasts) and mitochondria in energy transformations.

**BIO.A.3.2.1** Describe the basic transformation of energy during photosynthesis and cellular respiration.

**BIO.A.3.2.2** Describe the role of ATP in biochemical reactions.

#### **Performance Objectives**

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** describe the function of chloroplasts and mitochondria **IOT** explain their roles in energy transfer.
- **SWBAT** identify similarities and differences in photosynthesis and cellular respiration **IOT** compare types of energy transfer.
- **SWBAT** describe the role of ATP in biochemical reactions **IOT** explain how organisms obtain and transform energy for their life processes.

## Key Terms and Definitions

1. **Aerobic** - relating to, involving, or requiring free oxygen; "simple aerobic bacteria"
2. **Anaerobic** - an absence of free oxygen - "anaerobic bacteria"
3. **Adenosine Triphosphate (ATP)**: A molecule that provides energy for cellular reactions and processes. ATP releases energy when one of its high-energy bonds is broken to release a phosphate group.
4. **Bioenergetics**: The study of energy flow (energy transformations) into and within living systems.
5. **Cellular Respiration**: A complex set of chemical reactions involving an energy transformation where potential chemical energy in the bonds of "food" molecules is released and partially captured in the bonds of adenosine triphosphate (ATP) molecules.
6. **Chloroplast**: An organelle found in plant cells and the cells of other eukaryotic photosynthetic organisms where photosynthesis occurs.
7. **Energy transformation**: The process of changing one form of energy to another
8. **Mitochondria**: A membrane-bound organelle found in most eukaryotic cells; site of cellular respiration.
9. **Photosynthesis**: A process in which solar radiation is chemically captured by chlorophyll molecules and through a set of controlled chemical reactions resulting in the potential chemical energy in the bonds of carbohydrate molecules.
10. **Plastids**: A group of membrane-bound organelles commonly found in photosynthetic organisms and mainly responsible for the synthesis and storage of food.

## Biology: Term 2 Unit 4

**Topic:** Homeostasis and Transport

**Duration:** Traditional (50 minute periods): 13 - 18 days (adjust to student needs using professional discretion)

Block (90 minute periods): 6 - 8 days (adjust to student needs using professional discretion)

### Eligible Content

**BIO.A.4.1.1** Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.

**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.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).

## Performance Objectives

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** use representations, models, and informational text **IOT** support analysis of the properties of cell membranes and selective permeability based on molecular structure.
- **SWBAT** compare the mechanisms that transport materials across the plasma membrane [passive transport, diffusion, osmosis, facilitated diffusion, active transport] **IOT** deduce which type of transport would most likely take place in a given situation.
- **SWBAT** describe how the endoplasmic reticulum and golgi apparatus facilitate material transport **IOT** explain the organelles' roles in the maintenance of homeostasis.
- **SWBAT** describe thermoregulation, water regulation, and oxygen regulation in mammals at the cellular and system levels **IOT** explain how organisms maintain homeostasis.

## Key Terms and Definitions

1. **Carrier (transport) protein:** Proteins embedded in the plasma membrane involved in the movement of ions, small molecules, and macromolecules into and out of cells; also known as transport proteins.
2. **Concentration:** The measure of the amount or proportion of a given substance when combined with another substance.
3. **Concentration Gradient:** The graduated difference in a concentration of a solute per unit distance through a solution.
4. **Diffusion:** The movement of particles from an area of high concentration to an area of low concentration; a natural result of kinetic molecular energy.
5. **Endocytosis:** A process in which a cell engulfs extracellular material through an inward folding of its plasma membrane.
6. **Endoplasmic Reticulum:** An organelle, containing folded membranes and sacs, responsible for the production, processing, and transportation of materials for use inside and outside a eukaryotic cell. There are two forms of this organelle: rough ER that has surface ribosomes and participates in the synthesis of proteins mostly destined for export by the cell and smooth ER that has no ribosomes and participates in the synthesis of lipids and steroids as well as the transport of synthesized macromolecules.
7. **Exocytosis:** A process in which a cell releases substances to the extracellular environment by fusing a vesicular membrane with the plasma membrane, separating the membrane at the point of fusion and allowing the substance to be released.
8. **Extracellular:** located outside a cell
9. **Facilitated diffusion:** A process in which substances are transported across a plasma membrane with the concentration gradient with the aid of carrier (transport) proteins; does not require the use of energy
10. **Golgi apparatus:** An organelle found in eukaryotic cells responsible for the final stages of processing proteins for release by the cell.
11. **Homeostasis:** The process in which an organism regulates its internal environment.

12. **Homeostatic mechanism:** A regulatory mechanism that contributes to maintaining a state of equilibrium (e.g., thermoregulation, water regulation, and oxygen regulation).
13. **Impermeable:** Not permitting passage of a substance or substances.
14. **Intracellular:** Located inside a cell
15. **Osmosis:** The movement of water or another solvent through permeable membranes from an area of higher water concentration (dilute) to an area of lower water concentration (concentrated).
16. **Passive transport:** The transportation of materials across a plasma membrane without using energy.
17. **pH:** The measure of acidity or alkalinity (basicity) of an aqueous solution scaling from 1 (highly acidic) to 14 (highly alkaline) with a midpoint of 7 (neutral).
18. **Plasma membrane:** A thin, phospholipid and protein molecule bilayer that encapsulates a cell and controls the movement of materials in and out of the cell through active or passive transport.
19. **Pumps:** Any of several molecular mechanisms in which ions or molecules are transported across a cellular membrane requiring the use of an energy source (e.g., glucose, sodium [Na<sup>+</sup>], calcium [Ca<sup>+</sup>], and potassium [K<sup>+</sup>]).

### **Biology: Term 2 Unit 5**

**Topic:** Cell Growth and Reproduction (Mitosis & Meiosis)

**Duration:** Traditional (50 minute periods): 13 - 17 days (adjust to student needs using professional discretion)  
 Block (90 minute periods): 6 - 8 days (adjust to student needs using professional discretion)

#### **Eligible Content**

**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.1.2.1** Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.

**BIO.B.1.2.2** Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

#### **Performance Objectives**

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** use models **IOT** illustrate the role of the cell cycle, cellular division (mitosis), and differentiation in producing and maintaining complex organisms.



- **SWBAT** compare mitotic and meiotic nuclear divisions **IOT** differentiate between their processes and outcomes.
- **SWBAT** describe the process of DNA replication **IOT** explain the conservation of genetic information.
- **SWBAT** explain the functional relationships between DNA, genes, alleles, and chromosomes **IOT** articulate their roles in inheritance.

### Key Terms and Definitions

1. **Cell Cycle:** The series of events that take place in a cell leading to its division and duplication. The main phases of the cell cycle are interphase, nuclear division, and cytokinesis.
2. **Chromosomes:** A single piece of coiled DNA and associated proteins found in linear forms in the nucleus of eukaryotic cells and circular forms in the cytoplasm of prokaryotic cells; contains genes that encode traits. Each species has a characteristic number of chromosomes.
3. **Crossing-over:** An exchange of genetic material between homologous chromosomes during anaphase I of meiosis; contributes to the genetic variability in gametes and ultimately in offspring.
4. **Cytokinesis:** The final phase of a cell cycle resulting in the division of the cytoplasm
5. **Deoxyribonucleic Acid (DNA):** A biological macromolecule that encodes the genetic information for living organisms and is capable of self-replication and the synthesis of ribonucleic acid (RNA).
6. **DNA Replication:** the process in which DNA makes a duplicate copy of itself.
7. **Gamete:** a specialized cell (egg or sperm) used in sexual reproduction containing half the normal number of chromosomes of a somatic cell.
8. **Gene recombination:** A natural process in which a nucleic acid molecule (usually DNA but can be RNA) is broken and then joined to a different molecule; a result of crossing-over.
9. **Interphase:** The longest-lasting phase of the cell cycle in which a cell performs the majority of its functions, such as preparing for nuclear division and cytokinesis.
10. **Meiosis:** A two-phase nuclear division that results in the eventual production of gametes with half the normal number of chromosomes.
11. **Mitosis:** A nuclear division resulting in the production of two somatic cells having the same genetic complement as the original cell
12. **Semiconservative replication:** The process in which the DNA molecule uncoils and separates into two strands. Each original strand becomes a template on which a new strand is constructed, resulting in two DNA molecules identical to the original DNA molecule.

### **Biology: Term 3 Unit 6**

**Topic:** Genetics and Protein Synthesis

**Duration:** Traditional (50 minute periods): 17 - 20 days (adjust to student needs using professional discretion)

Block (90 minute periods): 8 - 11 days (adjust to student needs using professional discretion)

## Eligible Content

**BIO.B.2.1.1** Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, 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.2.2.1** Describe how the processes of transcription and translation are similar in all organisms.

**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.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.2.4.1** 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).

## Performance Objectives

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** apply understanding of Mendelian and non-Mendelian patterns of inheritance **IOT** predict or explain outcomes of genetic crosses
- **SWBAT** describe processes that can alter composition or number of chromosomes **IOT** explain genetic disorders.
- **SWBAT** describe the processes of transcription and translation **IOT** explain how proteins are synthesized from DNA.
- **SWBAT** describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins **IOT** explain the process of protein synthesis.
- **SWBAT** analyze the effects of changes in a DNA sequence on protein production **IOT** predict the likely outcome of a particular genetic mutation
- **SWBAT** apply scientific thinking, processes, tools, and technologies in the study of genetics **IOT** explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.

## Key Terms and Definitions

1. **Allele:** One of several alternative forms of a gene
2. **Biotechnology:** Any procedure or methodology that uses biological systems or living organisms to develop or modify either products or processes for specific use. This term is commonly associated with genetic engineering, which is one of many applications.
3. **Chromosomal mutation:** A change in the structure of a chromosome (e.g., deletion, the loss of a segment of a chromosome and thus the loss of segment containing genes; duplication, when a segment of a chromosome is duplicated and thus displayed more than once on the chromosome; inversion, when a segment of a chromosome breaks off and reattaches in reverse order; and translocation, when a segment of one chromosome breaks off and attaches to a nonhomologous chromosome).
4. **Cloning:** A process in which a cell, cell product, or organism is copied from an original source (e.g., DNA cloning, the transfer of a DNA fragment from one organism to a self-replicating genetic element such as a bacterial plasmid; reproductive cloning, the transfer of genetic material from the nucleus of a donor adult cell to an egg cell that has had its nucleus removed for the purpose of creating an embryo that can produce an exact genetic copy of the donor organism; or therapeutic cloning, the process of taking undifferentiated embryonic cells [stem cells] for use in medical research).
5. **Co-dominance:** A pattern of inheritance in which a heterozygous genotype results in the expression of the phenotypes of each allele fully and equally
6. **Dominant inheritance:** A pattern of inheritance in which the phenotypic effect of one allele is completely expressed within a homozygous and heterozygous genotype.
7. **Forensics:** The science of tests and techniques used during the investigation of crimes.
8. **Frame-shift mutation:** The addition (insertion mutation) or removal (deletion mutation) of one or more nucleotides that is not indivisible by three, therefore resulting in a completely different amino acid sequence than would be normal. The earlier in the sequence nucleotides are added or removed, the more altered the protein will be.
9. **Gene:** A short segment of DNA that codes for a protein product
10. **Gene expression:** The process by which a gene is used to make a protein
11. **Gene splicing:** A type of gene recombination in which the DNA is intentionally broken and recombined using laboratory techniques.
12. **Gene therapy:** The intentional insertion, alteration, or deletion of genes within an individual's cells and tissues for the purpose of treating a disease.
13. **Genetic engineering:** Altering the genetic material of a cell resulting in outcomes that would not occur naturally
14. **Genetically modified organism:** An organism whose genetic material has been altered through some genetic engineering technology or technique
15. **Genetics:** The scientific study of inheritance.
16. **Genotype:** The genetic composition of an organism
17. **Incomplete dominance:** A pattern of inheritance in which a heterozygous genotype results in the expression of a phenotype that is a blend of the phenotypes of each allele
18. **Inheritance:** The process in which genetic material is passed from parents to their offspring.
19. **Multiple alleles:** More than two forms of a gene controlling a trait
20. **Mutation:** A permanent, transmissible change of genetic material

21. **Nondisjunction:** The process in which sister chromatids fail to separate during and after mitosis or meiosis.
22. **Phenotype:** The observable expression of a genotype
23. **Point mutation:** A single-base substitution; includes silent mutations (resulting in no change in the amino acid coded for), missense mutations (resulting in the code for one amino acid being converted into the code for another); and nonsense mutations (resulting in the code for an amino acid being converted into a stop codon)
24. **Polygenic trait:** A trait in which phenotype is controlled by two or more genes at different loci on different chromosomes
25. **Protein synthesis:** The process in which proteins are formed through the transcription of DNA to mRNA, and the translation of mRNA to protein
26. **Recessive inheritance:** A pattern of inheritance in which the phenotypic effect of one allele is only expressed within a homozygous genotype. In a heterozygous condition with a dominant allele, it is not expressed in the phenotype.
27. **Selective breeding:** The process of breeding organisms that results on offspring with desired genetic traits.
28. **Sex-linked trait:** A genetic trait whose locus is on one of the sex chromosomes
29. **Transcription:** The process in which a strand of messenger RNA (mRNA) is synthesized using DNA as a template
30. **Translation:** The process in which a strand of amino acids (polypeptide) is synthesized using mRNA as a template
31. **Translocation:** The process in which a segment of a chromosome breaks off and attaches to another chromosome.

### **Biology: Term 3 Unit 7**

**Topic:** Theory of Evolution

**Duration:** Traditional (50 minute periods): 17 - 21 days (adjust to student needs using professional discretion)  
 Block (90 minute periods): 8 - 11 days (adjust to student needs using professional discretion)

#### **Eligible Content**

**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).

**BIO.B.3.3.1** Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.

## Performance Objectives

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** describe natural selection **in order to** explain impact to allele frequencies of a population.
- **SWBAT** describe isolating mechanisms, genetic drift, founder effect, migration **in order to** explain the development of new species.
- **SWBAT** explain genetic mutations **in order to** account for genotypic and phenotypic variations within a population.
- **SWBAT** analyze fossil, anatomical, physiological, embryological, biochemical, and universal genetic code evidence **in order to** evaluate the theory of evolution.
- **SWBAT** apply scientific thinking, processes, tools, and technologies **in order to** distinguish between the scientific terms: Hypothesis, inference, law, theory, principle, fact, and observation.

## Key Terms and Definitions

1. **Allele frequency:** The measure of the relative frequency of an allele in a population; expressed as a proportion or percent
2. **Analogous structure:** A physical structure, present in multiple species, that is similar in function but different in form and evolutionary origin
3. **Competition:** When individuals or groups of organisms compete for similar resources such as territory, mates, water, and food in the same environment.
4. **Embryology:** The branch of zoology studying the early development of living things.
5. **Endosymbiosis:** A theorized process in which early eukaryotic cells were formed from simpler prokaryotes.
6. **Evolution:** A process in which new species develop from preexisting species (biological evolution or macroevolution); a change in the allele frequencies of a population of organisms from generation to generation (genetic evolution or microevolution).
7. **Fossils:** The preserved remains or traces of organisms that once lived on Earth
8. **Founder effect:** A decrease in genetic variation caused by the formation of a new population by a small number of individuals from a larger population
9. **Genetic drift:** a change in allele frequency in the population as a result of chance events rather than natural selection
10. **Gradualism:** A proposed explanation in evolutionary biology stating that new species arise from the result of slight modifications (mutations and resulting phenotypic changes) over many generations
11. **Homologous structure:** a physical structure, present in multiple species, that was inherited from a common ancestor
12. **Hypothesis:** A proposed, scientifically testable explanation for an observed phenomenon.

13. **Isolating mechanisms:** Features of behavior, morphology, or genetics which serve to prevent mating or breeding between two different species (e.g. temporal isolation, in which individuals are active at different times of the day, seasons, or mating periods; ecological isolation, in which individuals only mate in a specific habitat; behavioral isolation, when there are no sexual cues between representatives of the species; mechanical isolation, when there is no sperm transfer during an attempted mating; and gametic incompatibility, when sperm transfer occurs without fertilization.) If mating can take place, there are four factors that prevent hybrid viability: zygotic mortality (fertilization but no zygote), hybrid inviability (embryo is not viable); hybrid sterility (Resulting adult is sterile); and hybrid breakdown (first generation is viable but future generations are not.)
14. **Law (scientific):** A law that generalizes a body of observations. At the time it is made, no exceptions have been found to a law. It explains things but does not describe them; serves as the basis of scientific principles.
15. **Migration (genetics):** The permanent movement of genes into or out of a population resulting in the change of allele frequencies
16. **Natural selection:** A process in nature in which organisms possessing certain inherited traits are better able to survive and reproduce compared to others of their species
17. **Population:** A group of organisms of the same species living in a specific location
18. **Principle (scientific):** A concept based on scientific laws and axioms (rules assumed to be present, true, and valid) where general agreement is present.
19. **Punctuated equilibrium:** A proposed explanation in evolutionary biology stating that species are generally stable over long periods of time. Occasionally there are rapid changes that affect some species which can quickly result in new species
20. **Selective breeding:** The process of breeding organisms that results in organisms with desired genetic traits
21. **Speciation:** A process typically caused by the genetic isolation from a main population resulting in a new genetically distinct species
22. **Species:** The lowest taxonomic level of biological classification consisting of organisms capable of reproduction that results in fertile offspring.
23. **Theory (scientific):** An explanation of observable phenomena based on available empirical data and guided by a system of logic that includes scientific laws; provides a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict, or otherwise explain the nature or behavior of a specific set of phenomena.
24. **Vestigial structure:** A physical characteristic in organisms that appears to have lost its original function as the species has changed over time

### **Biology: Term 4 Unit 8**

**Topic:** Ecology

**Duration:** Traditional (50 minute periods): 26 - 30 days (adjust to student needs using professional discretion)  
 Block (90 minute periods): 12 - 15 days (adjust to student needs using Professional discretion)

## Eligible Content

**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.

## Performance Objectives

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** compare organisms in different biomes **IOT** describe levels of ecological organization (organism, population, community, ecosystem, biome, and biosphere).
- **SWBAT** cite textual evidence **IOT** describe characteristics of biotic and abiotic components of terrestrial and aquatic ecosystems.
- **SWBAT** analyze models and graphs **IOT** describe how energy flows through an ecosystem.
- **SWBAT** map food chains **IOT** describe biotic interactions in an ecosystem (competition, predation, symbiosis).
- **SWBAT** diagram the water cycle, carbon cycle, oxygen cycle, and nitrogen cycle **IOT** describe how matter recycles through an ecosystem.
- **SWBAT** give examples of climate change, introduction of nonnative species in PA, pollution, and fires **IOT** describe how ecosystems change in response to natural and human disturbances.
- **SWBAT** define limiting factors **IOT** describe population dynamics and potential species extinction.

## Key Terms and Definitions

1. **Abiotic:** A term that describes a non-living factor in an ecosystem
2. **Aquatic:** A term that describes an organism or habitat associated with a water environment
3. **Biogeochemical cycles:** The movement of abiotic factors between the living and nonliving components within ecosystems; also known as nutrient cycles (i.e. water cycle, carbon cycle, oxygen cycle, and nitrogen cycle)
4. **Biome:** A large area or geographical region with distinct plant and animal groups adapted to that environment
5. **Biosphere:** The zone of life on Earth; sum total of all ecosystems on Earth
6. **Biotic:** A term that describes a living or once-living organism in an ecosystem
7. **Community (ecological):** Different populations of organisms interacting in a shared environment
8. **Competition:** When individuals or groups of organisms compete for similar resources such as territory, mates, water, and food in the same environment
9. **Consumer (ecological):** An organism that obtains energy by feeding on other organisms or their remains
10. **Decomposer:** An organism that obtains nutrients by consuming dead and decaying organic matter which allows nutrients to be accessible to other organisms
11. **Ecology:** The study of relationships between organisms and their interactions with the environment
12. **Ecosystem:** A system composed of organisms and nonliving components of the environment
13. **Endemic species:** A species that is found in its originating location and is generally restricted to that geographic area
14. **Energy pyramid:** A model that illustrates the biomass productivity at multiple trophic levels in a given ecosystem
15. **Energy transformation:** A process in which energy changes from one form to another form while some energy is lost to the environment
16. **Environment:** The total surroundings of an organism or a group of organisms
17. **Extinction:** A term that typically describes a species that no longer has any known living members
18. **Food chain:** A simplified path illustrating the passing of potential chemical energy (food) from one organism to another organism
19. **Food web:** A complex arrangement of interrelated food chains showing the flow of energy between interdependent organisms
20. **Habitat:** An area that provides an organism with its basic needs for survival
21. **Limiting factor:** Chemical or physical factor that limits the existence, growth, abundance or distribution of an individual organism or population
22. **Nonnative species:** A species normally living outside a distribution range that has been introduced either through deliberate or accidental human activity; also can be known as introduced, invasive, alien, nonindigenous, or exotic
23. **Organism:** A form of life; an animal, plant, fungus, protist, or bacterium
24. **Population:** A group of individuals of the same species living in a specific geographical area and reproducing
25. **Population dynamics:** The study of short- and long-term changes in the number of individuals in a given population, as affected by birth, death, immigration, and emigration



26. **Producer** (ecological): An organism that uses a primary energy source to conduct photosynthesis or chemosynthesis
27. **Species**: The lowest taxonomic level of biological classification consisting of organisms capable of reproduction that results in fertile offspring.
28. **Succession**: A series of predictable and orderly changes within an ecosystem over time
29. **Symbiotic relationship**: A relationship between two organisms (i.e. mutualism, in which both organisms benefit; parasitism, in which organism benefits and the other is harmed; and commensalism, in which one organism benefits and the other organism does not benefit and is not harmed)
30. **Terrestrial**: A term that describes an organism or habitat associated with a land environment
31. **Trophic level**: The position of an organism in relation to the flow of energy and inorganic nutrients through an ecosystem (i.e. producer, consumer, and decomposer)

### **Biology: Term 4 Unit 9**

**Topic:** Environmental Science

**Duration:** Traditional (50 minute periods): 12 - 17 days (adjust to student needs using professional discretion)  
 Block (90 minute periods) : 5 - 7 days (adjust to student needs using professional discretion)

#### **Eligible Content**

**BIO.B.4.1.2:** Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.

**BIO.B.4.2.4:** Describe how ecosystems change in response to natural and human disturbances.

**BIO.B.4.2.5:** Describe the effects of limiting factors on population dynamics and potential species extinction.

#### **Performance Objectives**

**SWBAT:** *These are examples, created by SDP teachers, of how you may translate the eligible content into learning goals for your classroom.*

- **SWBAT** describe Malthus' theory of population growth and the current food supply in PA **IOT** argue for and against industrial agricultural practices.
- **SWBAT** define industrial farming and industrial meat production **IOT** classify farms as industrial or family farms.
- **SWBAT** cite textual evidence from 3 articles on industrial agriculture **IOT** analyze the social, political, economic, and environmental factors that affect agricultural systems.

- **SWBAT** examine the logistics of 1 plant (ex. corn or soy) and 1 animal (ex. pig or cow) processing from farm to table **IOT** explain the relationships between and among the components of the food and fiber system (production, processing, research and development, marketing, distribution, and regulations.)
- **SWBAT** list the top crops and livestock exports of PA **IOT** analyze the effects of agriculture on PA's economy, environment, standard of living, and foreign trade.
- **SWBAT** cite evidence from concentrated animal feeding operations (CAFO) **IOT** evaluate the use of technologies to increase animal productivity.

### Key Terms and Definitions

1. **Agribusiness** – a business that earns revenue from agriculture
2. **agriculture** - the production of food, feed, fiber, and other goods by the systematic growing/harvesting of plants, animals, and other life forms
3. **biotic** - living or once living organism in an ecosystem
4. **abiotic** - nonliving factors in an ecosystem
5. **fiber** - parts of plants and animals used for non-food products
6. **lagoons** - large ponds or lakes that contain manure and run off from CAFOs
7. **CAFO** - Concentrated Animal Feeding Operations
8. **farm** - A farm is defined as any place from which \$1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the year. Since the definition allows for farms to be included even if they did not have at least \$1,000 in sales, but normally would have, a system is developed by USDA's National Agricultural Statistics Service for determining when a farm normally would have. These are called point farms. If a place does not have \$1,000 in sales, a "point system" assigns dollar values for acres of various crops and head of various livestock species to estimate a normal level of sales. Point farms are farms with fewer than \$1,000 in sales but have points worth at least \$1,000. <http://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/glossary.aspx>
9. **family farm** - There is no hard-and-fast definition of a family farm, unlike the farm definition; The current definition of a family farm, since 2005, based on the Agricultural Resource Management Survey is one in which the majority of the business is owned by the operator and individuals related to the operator by blood, marriage, or adoption, including relatives that do not live in the operator household. Although the definition of a family farm has changed somewhat over time, the share of U.S. farms classified as family farms has changed little since 1996, ranging from 97.1 to 98.3 percent of all farms (see the data table on family and nonfamily farms, by farm size class (gross sales), 1996-2011). <http://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/glossary.aspx>
10. **factory farming** - At the very basic definition, a factory farm is usually a large industrial facility where livestock are crowded together. Technically, factory farms are known as Concentrated (or Confined) Animal Feeding Operations (CAFOs): Defined by the Environmental Protection Agency (EPA) as "*New and existing operations which stable or confine and feed or maintain for a total of 45 days or more in any 12-month period more than the number of animals specified.*" Also the EPA notes that factory farms have, "*No*

*grass or other vegetation in the confinement area during the normal growing season.” <http://organic.about.com/od/organicdefinitionsef/g/Factory-Farm-Definition-Of-Factory-Farm.htm>*

11. **livestock** - farm animals regarded as an asset pasture - grass or other plants for feeding livestock