WARREN COUNTY SCHOOL DISTRICT

PLANNED INSTRUCTION

COURSE DESCRIPTION

Course Title: AP Biology
Course Number: 00316
Course Prerequisites: Biology College Preparatory, Honors Biology, and Chemistry College Preparatory

Course Description: Advanced Placement Biology is offered to students who have completed Biology College Preparatory, Advanced Biology, and Chemistry College Preparatory. The College Board's Advanced Placement (AP) program provides capable and motivated students with an opportunity to pursue college level biological studies with still in secondary school. This course is a college level laboratory program that enables students to receive college credit by passing a test with appropriate scores in May of the school year. This course is not taught to Pennsylvania standards, it is taught to college board standards. https://apcentral.collegeboard.org/courses/ap-biology/course

Suggested Grade Level: Grades 11-12
Length of Course: Two Semesters
Units of Credit: 1
PDE Certification and Staffing Policies and Guidelines (CSPG) Required Teacher Certifications:
CSPG 32 Biology
To find the CSPG information, go to CSPG
Certification verified by the WCSD Human Resources Department: ☒Yes ☐No

WCSD STUDENT DATA SYSTEM INFORMATION

Course Level: AP (1) GPA +10%
Mark Types: Check all that apply.
☒F – Final Average ☒MP – Marking Period ☒EXM – Final Exam

GPA Type: ☐ GPAEL-GPA Elementary ☐ GPAML-GPA for Middle Level ☒ NHS-National Honor Society
☒ UGPA-Non-Weighted Grade Point Average ☒ GPA-Weighted Grade Point Average

State Course Code: 03056
To find the State Course Code, go to State Course Code, download the Excel file for *SCED*, click on SCED 6.0 tab, and choose the correct code that corresponds with the course.

TEXTBOOKS AND SUPPLEMENTAL MATERIALS

Board Approved Textbooks, Software, and Materials:

Title:	Campbell Biology AP Edition 11th Edition + AP Test Prep
Publisher:	Pearson
ISBN #:	10:0-13-443369-6
Copyright Date:	2018
WCSD Board Approval Date:	5/14/2018

Supplemental Materials:

Curriculum Document

WCSD Board Approval:

Date Finalized:	1/10/2025
Date Approved:	2/10/2025
Implementation Year:	2025-2026

SPECIAL EDUCATION, 504, and GIFTED REQUIREMENTS

The teacher shall make appropriate modifications to instruction and assessment based on a student's Individual Education Plan (IEP), Chapter 15 Section 504 Plan (504), and/or Gifted Individual Education Plan (GIEP).

SCOPE AND SEQUENCE OF CONTENT AND CONCEPTS

Marking Period 1

- Chemistry of Life
- Cell Structure and Function

Marking Period 2

- Cellular Genetics
- Cellular Communication and Cell Cycle

Marking Period 3

- Heredity
- Gene Expression and Regulation

Marking Period 4

- Natural Selection
- Ecology

Labs: A minimum of 8 inquiry-based labs (2 per Big Ideas) is required.
Labs may be completed in any order.

- Evolution: Artificial Selection
- Evolution: Mathematical Modeling: Hardy-Weinberg
- Evolution: Comparing DNA Sequences to Understand Evolutionary Relationships

- Energetics: Diffusion and Osmosis
- Energetics: Photosynthesis
- Energetics: Cellular Respiration

- Information Storage and Transmission: Cell Division Mitosis and Meiosis
- Information Storage and Transmission: Biotechnology: Bacterial Transformation
- Information Storage and Transmission: Biotechnology: Restriction Enzyme Analysis of DNA

- Systems Interactions: Energy Dynamics
- Systems Interactions: Transpiration
- Systems Interactions: Fruit Fly Behaviors
- Systems Interactions: Enzyme Activity

Standards/Eligible Content and Skills

Performance Indicator	**College Board Advanced Placement Program Standards**	**Marking Period Taught**
Living systems are organized in a hierarchy of structural levels that interact.	SCI.9-12.SYI-1	MP1
Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.	SCI.9-12.SYI-1.A	MP1
The subcomponents of biological molecules and their sequence determine the properties of that molecule.	SCI.9-12.SYI-1.A.1	MP1
Living systems depend on properties of water that result from its polarity and hydrogen bonding.	SCI.9-12.SYI-1.A.2	MP1
The hydrogen bonds between water molecules result in cohesion, adhesion, and surface tension.	SCI.9-12.SYI-1.A.3	MP1
The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.	SCI.9-12.ENE-1	MP1
Describe the composition of macromolecules required by living organisms.	SCI.9-12.ENE-1.A	MP1
Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.	SCI.9-12.ENE-1.A.1	MP1
Atoms and molecules from the environment are necessary to build new molecules.	SCI.9-12.ENE-1.A.2	MP1
Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.	SCI.9-12.ENE-1.A.2.a	MP1
Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.	SCI.9-12.ENE-1.A.2.b	MP1
Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.	SCI.9-12.SYI-1.B	MP1
Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.	SCI.9-12.SYI-1.B.1	MP1
Structure and function of polymers are derived from the way their monomers are assembled.	SCI.9-12.SYI-1.B.2	MP1
In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate, and a nitrogen base (adenine, thymine, guanine, cytosine, or uracil). DNA and RNA differ in structure and function.	SCI.9-12.SYI-1.B.2.a	MP1
In proteins, the specific order of amino acids in a polypeptide (primary structure) determines the overall shape of the protein. Amino acids have directionality, with an amino (NH_2) terminus and a carboxyl (COOH) terminus. The R group of an amino acid can be categorized by chemical properties (hydrophobic, hydrophilic, or ionic), and the interactions of these R groups determine structure and function of that region of the protein.	SCI.9-12.SYI-1.B.2.b	MP1

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Complex carbohydrates comprise sugar monomers whose structures determine the properties and functions of the molecules.	SCI.9-12.SYI-1.B.2.c	MP1
Lipids are nonpolar macromolecules.	SCI.9-12.SYI-1.B.2.d.	MP1
Differences in saturation determine the structure and function of lipids.	SCI.9-12.SYI-1.B.2.d.i	MP1
Phospholipids contain polar regions that interact with other polar molecules, such as water, and with nonpolar regions that are often hydrophobic.	SCI.9-12.SYI-1.B.2.d.ii	MP1
Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.	SCI.9-12.SYI.1.C	MP1
Directionality of the subcomponents influences structure and function of the polymer.	SCI.9-12.SYI.1.C.1	MP1
Nucleic acids have a linear sequence of nucleotides that have ends, defined by the 3’ hydroxyl and 5’ phosphates of the sugar in the nucleotide. During DNA and RNA synthesis, nucleotides are added to the 3’ end of the growing strand, resulting in the formation of a covalent bond between nucleotides.	SCI.9-12.SYI.1.C.1a	MP1
DNA is structured as an antiparallel double helix, with each strand running in opposite 5’ to 3’ orientation. Adenine nucleotides pair with thymine nucleotides via two hydrogen bonds. Cytosine nucleotides pair with guanine nucleotides by three hydrogen bonds.	SCI.9-12.SYI.1.C.1b	MP1
Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.	SCI.9-12.SYI.1.C.1c	MP1
Proteins have primary structure determined by the sequence order of their constituent amino acids, secondary structure that arises through local folding of the amino acid chain into elements such as alpha-helices and beta-sheets, tertiary structure that is the overall three-dimensional shape of the protein and often minimizes free energy, and quaternary structure that arises from interactions between multiple polypeptide units. The four elements of protein structure determine the function of a protein.	SCI.9-12.SYI.1.C.1d	MP1
Carbohydrates comprise linear chains of sugar monomers connected by covalent bonds. Carbohydrate polymers may be linear or branched.	SCI.9-12.SYI.1.C.1e	MP1
Heritable information provides for continuity of life.	SCI.9-12.IST-1	MP1
Describe the structural similarities and differences between DNA and RNA.	SCI.9-12.IST-1.A	MP1
NA and RNA molecules have structural similarities and differences related to their function.	SCI.9-12.IST-1.A.1	MP1
Both DNA and RNA have three components—sugar, a phosphate group, and a nitrogenous base—that form nucleotide units that are	SCI.9-12.IST-1.A.1a	MP1

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
connected by covalent bonds to form a linear molecule with 5’ and 3’ ends, with the nitrogenous bases perpendicular to the sugar-phosphate backbone.		
The basic structural differences between DNA and RNA include the following:	SCI.9-12.IST-1.A.1b	MP1
DNA contains deoxyribose and RNA contains ribose.	SCI.9-12.IST-1.A.1b.i	MP1
RNA contains uracil and DNA contains thymine.	SCI.9-12.IST-1.A.1b.ii	MP1
DNA is usually double stranded; RNA is usually single stranded.	SCI.9-12.IST-1.A.1b.iii	MP1
The two DNA strands in double-stranded DNA are antiparallel in directionality.	SCI.9-12.IST-1.A.1b.iv	MP1
Describe the structure and/ or function of subcellular components and organelles.	SCI.9-12.SYI-1.D	MP1
Ribosomes comprise ribosomal RNA (rRNA) and protein. Ribosomes synthesize protein according to mRNA sequence.	SCI.9-12.SYI-1.D.1	MP1
Ribosomes are found in all forms of life, reflecting the common ancestry of all known life.	SCI.9-12.SYI-1.D.2	MP1
Endoplasmic reticulum (ER) occurs in two forms—smooth and rough. Rough ER is associated with membrane-bound ribosomes.	SCI.9-12.SYI-1.D.3	MP1
Rough ER compartmentalizes the cell.	SCI.9-12.SYI-1.D.3a	MP1
Smooth ER functions include detoxification and lipid synthesis.	SCI.9-12.SYI-1.D.3b	MP1
The Golgi complex is a membrane-bound structure that consists of a series of flattened membrane sacs.	SCI.9-12.SYI-1.D.4	MP1
Functions of the Golgi include the correct folding and chemical modification of newly synthesized proteins and packaging for protein trafficking.	SCI.9-12.SYI-1.D.4a	MP1
Mitochondria have a double membrane. The outer membrane is smooth, but the inner membrane is highly convoluted, forming folds.	SCI.9-12.SYI-1.D.4b	MP1
Lysosomes are membrane-enclosed sacs that contain hydrolytic enzymes.	SCI.9-12.SYI-1.D.4c	MP1
A vacuole is a membrane-bound sac that plays many and differing roles. In plants, a specialized large vacuole serves multiple functions.	SCI.9-12.SYI-1.D.4d	MP1
Chloroplasts are specialized organelles that are found in photosynthetic algae and plants. Chloroplasts have a double outer membrane.	SCI.9-12.SYI-1.D.4e	MP1
Explain how subcellular components and organelles contribute to the function of the cell.	SCI.9-12.SYI-1.E	MP1
Organelles and subcellular structures, and the interactions among them, support cellular function.	SCI.9-12.SYI-1.E.1	MP1
Endoplasmic reticulum provides mechanical support, carries out protein synthesis on membrane-bound ribosomes, and plays a role in intracellular transport.	SCI.9-12.SYI-1.E.1a	MP1

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Mitochondrial double membrane provides compartments for different metabolic reactions.	SCI.9-12.SYI-1.E.1b	MP1
Lysosomes contain hydrolytic enzymes, which are important in intracellular digestion, the recycling of a cell's organic materials, and programmed cell death (apoptosis).	SCI.9-12.SYI-1.E.1c	MP1
Vacuoles have many roles, including storage and release of macromolecules and cellular waste products. In plants, it aids in retention of water for turgor pressure.	SCI.9-12.SYI-1.E.1d	MP1
Describe the structural features of a cell that allow organisms to capture, store, and use energy.	SCI.9-12.SYI-1.F	MP1
The folding of the inner membrane increases the surface area, which allows for more ATP to be synthesized.	SCI.9-12.SYI-1.F.1	MP1
Within the chloroplast are thylakoids and the stroma.	SCI.9-12.SYI-1.F.2	MP1
The thylakoids are organized in stacks, called grana.	SCI.9-12.SYI-1.F.3	MP1
Membranes contain chlorophyll pigments and electron transport proteins that comprise the photosystems.	SCI.9-12.SYI-1.F.4	MP1
The light-dependent reactions of photosynthesis occur in the grana.	SCI.9-12.SYI-1.F.5	MP1
The stroma is the fluid within the inner chloroplast membrane and outside of the thylakoid.	SCI.9-12.SYI-1.F.6	MP1
The carbon fixation (Calvin-Benson cycle) reactions of photosynthesis occur in the stroma.	SCI.9-12.SYI-1.F.7	MP1
The Krebs cycle (citric acid cycle) reactions occur in the matrix of the mitochondria.	SCI.9-12.SYI-1.F.8	MP1
Electron transport and ATP synthesis occur on the inner mitochondrial membrane.	SCI.9-12.SYI-1.F.9	MP1
Explain the effect of surface area-to-volume ratios on the exchange of materials between cells or organisms and the environment.	SCI.9-12.ENE-1.B	MP1
Surface area-to-volume ratios affect the ability of a biological system to obtain necessary resources, eliminate waste products, acquire or dissipate thermal energy, and otherwise exchange chemicals and energy with the environment.	SCI.9-12.ENE-1.B.1	MP1
The surface area of the plasma membrane must be large enough to adequately exchange materials.	SCI.9-12.ENE-1.B.2	MP1
These limitations can restrict cell size and shape. Smaller cells typically have a higher surface area-to-volume ratio and more efficient exchange of materials with the environment.	SCI.9-12.ENE-1.B.2a	MP1
As cells increase in volume, the relative surface area decreases and the demand for internal resources increases.	SCI.9-12.ENE-1.B.2b	MP1
More complex cellular structures (e.g., membrane folds) are necessary to adequately exchange materials with the environment.	SCI.9-12.ENE-1.B.2c	MP1

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As organisms increase in size, their surface area-to-volume ratio decreases, affecting properties like rate of heat exchange with the environment.	SCI.9-12.ENE-1.B.2d	MP1
Explain how specialized structures and strategies are used for the efficient exchange of molecules to the environment.	SCI.9-12.ENE-1.C	MP1
Organisms have evolved highly efficient strategies to obtain nutrients and eliminate wastes. Cells and organisms use specialized exchange surfaces to obtain and release molecules from or into the surrounding environment.	SCI.9-12.ENE-1.C.1	MP1
Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.	SCI.9-12.ENE-2	MP1
Describe the roles of each of the components of the cell membrane in maintaining the internal environment of the cell.	SCI.9-12.ENE-2.A	MP1
Phospholipids have both hydrophilic and hydrophobic regions. The hydrophilic phosphate regions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid regions face each other within the interior of the membrane.	SCI.9-12.ENE-2.A.1	MP1
Embedded proteins can be hydrophilic, with charged and polar side groups, or hydrophobic, with nonpolar side groups.	SCI.9-12.ENE-2.A.2	MP1
Describe the Fluid Mosaic Model of cell membranes.	SCI.9-12.ENE-2.B	MP1
Cell membranes consist of a structural framework of phospholipid molecules that is embedded with proteins, steroids (such as cholesterol in eukaryotes), glycoproteins, and glycolipids that can flow around the surface of the cell within the membrane.	SCI.9-12.ENE-2.B.1	MP1
Explain how the structure of biological membranes influences selective permeability.	SCI.9-12.ENE-2.C	MP1
The structure of cell membranes results in selective permeability.	SCI.9-12.ENE-2.C.1	MP1
Cell membranes separate the internal environment of the cell from the external environment.	SCI.9-12.ENE-2.C.2	MP1
Selective permeability is a direct consequence of membrane structure, as described by the fluid mosaic model.	SCI.9-12.ENE-2.C.3	MP1
Small nonpolar molecules, including N_2, O_2, and CO_2, freely pass across the membrane. Hydrophilic substances, such as large polar molecules and ions, move across the membrane through embedded channel and transport proteins.	SCI.9-12.ENE-2.C.4	MP1
Polar uncharged molecules, including H_2O, pass through the membrane in small amounts.	SCI.9-12.ENE-2.C.5	MP1
Describe the role of the cell wall in maintaining cell structure and function.	SCI.9-12.ENE-2.D	MP1

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Cell walls provide a structural boundary, as well as a permeability barrier for some substances to the internal environments.	SCI.9-12.ENE-2.D.1	MP1
Cell walls of plants, prokaryotes, and fungi are composed of complex carbohydrates.	SCI.9-12.ENE-2.D.2	MP1
Describe the mechanisms that organisms use to maintain solute and water balance.	SCI.9-12.ENE-2.E	MP1
Passive transport is the net movement of molecules from high concentration to low concentration without the direct input of metabolic energy.	SCI.9-12.ENE-2.E.1	MP1
Passive transport plays a primary role in the import of materials and the export of wastes.	SCI.9-12.ENE-2.E.2	MP1
Active transport requires the direct input of energy to move molecules from regions of low concentration to regions of high concentration.	SCI.9-12.ENE-2.E.3	MP1
Describe the mechanisms that organisms use to transport large molecules across the plasma membrane.	SCI.9-12.ENE-2.F	MP1
The selective permeability of membranes allows for the formation of concentration gradients of solutes across the membrane.	SCI.9-12.ENE-2.F.1	MP1
The processes of endocytosis and exocytosis require energy to move large molecules into and out of cells.	SCI.9-12.ENE-2.F.2	MP1
In exocytosis, internal vesicles fuse with the plasma membrane and secrete large macromolecules out of the cell.	SCI.9-12.ENE-2.F.2a	MP1
In endocytosis, the cell takes in macromolecules and particulate matter by forming new vesicles derived from the plasma membrane.	SCI.9-12.ENE-2.F.2b	MP1
Explain how the structure of a molecule affects its ability to pass through the plasma membrane.	SCI.9-12.ENE-2.G	MP1
Membrane proteins are required for facilitated diffusion of charged and large polar molecules through a membrane.	SCI.9-12.ENE-2.G.1	MP1
Large quantities of water pass through aquaporins.	SCI.9-12.ENE-2.G.1a	MP1
Charged ions, including Na^+ and K^+, require channel proteins to move through the membrane.	SCI.9-12.ENE-2.G.1b	MP1
Membranes may become polarized by movement of ions across the membrane.	SCI.9-12.ENE-2.G.1c	MP1
Membrane proteins are necessary for active transport.	SCI.9-12.ENE-2.G.2	MP1
Metabolic energy (such as from ATP) is required for active transport of molecules and/ or ions across the membrane and to establish and maintain concentration gradients.	SCI.9-12.ENE-2.G.3	MP1
The Na^+/K^+ ATPase contributes to the maintenance of the membrane potential.	SCI.9-12.ENE-2.G.4	MP1
Explain how concentration gradients affect the movement of molecules across membranes.	SCI.9-12.ENE-2.H	MP1

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External environments can be hypotonic, hypertonic or isotonic to internal environments of cells.	SCI.9-12.ENE-2.H.1	MP1
Water moves by osmosis from areas of high water potential/low osmolarity/ low solute concentration to areas of low water potential/high osmolarity/high solute concentration.	SCI.9-12.ENE-2.H.1a	MP1
Explain how osmoregulatory mechanisms contribute to the health and survival of organisms.	SCI.9-12.ENE-2.I	MP1
Growth and homeostasis are maintained by the constant movement of molecules across membranes.	SCI.9-12.ENE-2.I.1	MP1
Osmoregulation maintains water balance and allows organisms to control their internal solute composition/water potential.	SCI.9-12.ENE-2.I.2	MP1
Describe the processes that allow ions and other molecules to move across membranes.	SCI.9-12.ENE-2.J	MP1
A variety of processes allow for the movement of ions and other molecules across membranes, including passive and active transport, endocytosis and exocytosis.	SCI.9-12.ENE-2.J.1	MP1
Describe the membrane- bound structures of the eukaryotic cell.	SCI.9-12.ENE-2.K	MP1
Membranes and membrane-bound organelles in eukaryotic cells compartmentalize intracellular metabolic processes and specific enzymatic reactions.	SCI.9-12.ENE-2.K.1	MP1
Explain how internal membranes and membrane- bound organelles contribute to compartmentalization of eukaryotic cell functions.	SCI.9-12.ENE-2.L	MP1
Internal membranes facilitate cellular processes by minimizing competing interactions and by increasing surface areas where reactions can occur.	SCI.9-12.ENE-2.L.1	MP1
Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.	SCI.9-12.EVO-1	MP1
Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells.	SCI.9-12.EVO-1.A	MP1
Membrane-bound organelles evolved from once free-living prokaryotic cells via endosymbiosis.	SCI.9-12.EVO-1.A.1	MP1
Prokaryotes generally lack internal membrane- bound organelles but have internal regions with specialized structures and functions.	SCI.9-12.EVO-1.A.2	MP1
Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	SCI.9-12.EVO-1.A.3	MP1
Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral counterparts.	SCI.9-12.EVO-1.B	MP1
Membrane-bound organelles evolved from previously free-living prokaryotic cells via endosymbiosis.	SCI.9-12.EVO-1.B.1	MP1
Describe the properties of enzymes.	SCI.9-12.ENE-1.D	MP2
The structure of enzymes includes the active site that specifically interacts with substrate molecules.	SCI.9-12.ENE-1.D.1	MP2

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For an enzyme-mediated chemical reaction to occur, the shape and charge of the substrate must be compatible with the active site of the enzyme.	SCI.9-12.ENE-1.D.2	MP2
Explain how enzymes affect the rate of biological reactions.	SCI.9-12.ENE-1.E	MP2
The structure and function of enzymes contribute to the regulation of biological processes.	SCI.9-12.ENE-1.E.1	MP2
Enzymes are biological catalysts that facilitate chemical reactions in cells by lowering the activating energy.	SCI.9-12.ENE-1.E.1a	MP2
Explain how changes to the structure of an enzyme may affect its function.	SCI.9-12.ENE-1.F	MP2
Change to the molecular structure of a component in an enzymatic system may result in a change of the function or efficiency of the system.	SCI.9-12.ENE-1.F.1	MP2
Denaturation of an enzyme occurs when the protein structure is disrupted, eliminating the ability to catalyze reactions.	SCI.9-12.ENE-1.F.1a	MP2
Environmental temperatures and pH outside the optimal range for a given enzyme will cause changes to its structure, altering the efficiency with which it catalyzes reactions.	SCI.9-12.ENE-1.F.1b	MP2
In some cases, enzyme denaturation is reversible, allowing the enzyme to regain activity.	SCI.9-12.ENE-1.F.2	MP2
Explain how the cellular environment affects enzyme activity.	SCI.9-12.ENE-1.G	MP2
Environmental pH can alter the efficiency of enzyme activity, including through disruption of hydrogen bonds that provide enzyme structure.	SCI.9-12.ENE-1.G.1	MP2
The relative concentrations of substrates and products determine how efficiently an enzymatic reaction proceeds.	SCI.9-12.ENE-1.G.2	MP2
Higher environmental temperatures increase the speed of movement of molecules in a solution, increasing the frequency of collisions between enzymes and substrates and therefore increasing the rate of reaction.	SCI.9-12.ENE-1.G.3	MP2
Competitive inhibitor molecules can bind reversibly or irreversibly to the active site of the enzyme. Noncompetitive inhibitors can bind allosteric sites, changing the activity of the enzyme.	SCI.9-12.ENE-1.G.4	MP2
Describe the role of energy in living organisms.	SCI.9-12.ENE-1.H	MP2
All living systems require constant input of energy.	SCI.9-12.ENE-1.H.1	MP2
Life requires a highly ordered system and does not violate the second law of thermodynamics.	SCI.9-12.ENE-1.H.2	MP2
Energy input must exceed energy loss to maintain order and to power cellular processes.	SCI.9-12.ENE-1.H.2a	MP2
Cellular processes that release energy may be coupled with cellular processes that require energy.	SCI.9-12.ENE-1.H.2b	MP2
Loss of order or energy flow results in death.	SCI.9-12.ENE-1.H.2c	MP2

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Energy-related pathways in biological systems are sequential to allow for a more controlled and efficient transfer of energy. A product of a reaction in a metabolic pathway is generally the reactant for the subsequent step in the pathway.	SCI.9-12.ENE-1.H.3	MP2
Describe the photosynthetic processes that allow organisms to capture and store energy.	SCI.9-12.ENE-1.I	MP2
Organisms capture and store energy for use in biological processes.	SCI.9-12.ENE-1.I.1	MP2
Photosynthesis captures energy from the sun and produces sugars.	SCI.9-12.ENE-1.I.1a	MP2
Photosynthesis first evolved in prokaryotic organisms.	SCI.9-12.ENE-1.I.1a.i	MP2
Scientific evidence supports the claim that prokaryotic (cyanobacterial) photosynthesis was responsible for the production of an oxygenated atmosphere.	SCI.9-12.ENE-1.I.1a.ii	MP2
Prokaryotic photosynthetic pathways were the foundation of eukaryotic photosynthesis.	SCI.9-12.ENE-1.I.1a.iii	MP2
The light-dependent reactions of photosynthesis in eukaryotes involve a series of coordinated reaction pathways that capture energy present in light to yield ATP and NADPH, which power the production of organic molecules.	SCI.9-12.ENE-1.I.2	MP2
Explain how cells capture energy from light and transfer it to biological molecules for storage and use.	SCI.9-12.ENE-1.J	MP2
During photosynthesis, chlorophylls absorb energy from light, boosting electrons to a higher energy level in photosystems I and II.	SCI.9-12.ENE-1.J.1	MP2
Photosystems I and II are embedded in the internal membranes of chloroplasts and are connected by the transfer of higher energy electrons through an electron transport chain (ETC).	SCI.9-12.ENE-1.J.2	MP2
When electrons are transferred between molecules in a sequence of reactions as they pass through the ETC, an electrochemical gradient of protons (hydrogen ions) is established across the internal membrane.	SCI.9-12.ENE-1.J.3	MP2
The formation of the proton gradient is linked to the synthesis of ATP from ADP and inorganic phosphate via ATP synthase.	SCI.9-12.ENE-1.J.4	MP2
The energy captured in the light reactions and transferred to ATP and NADPH powers the production of carbohydrates from carbon dioxide in the Calvin cycle, which occurs in the stroma of the chloroplast.	SCI.9-12.ENE-1.J.5	MP2
Describe the processes that allow organisms to use energy stored in biological macromolecules.	SCI.9-12.ENE-1.K	MP2
Fermentation and cellular respiration use energy from biological macromolecules to produce ATP. Respiration and fermentation are characteristic of all forms of life.	SCI.9-12.ENE-1.K.1	MP2
Cellular respiration in eukaryotes involves a series of coordinated enzyme-catalyzed reactions that capture energy from biological macromolecules.	SCI.9-12.ENE-1.K.2	MP2

Performance Indicator	**College Board Advanced Placement Program Standards**	**Marking Period Taught**
The electron transport chain transfers energy from electrons in a series of coupled reactions that establish an electrochemical gradient across membranes.	SCI.9-12.ENE-1.K.3	MP2
Electron transport chain reactions occur in chloroplasts, mitochondria, and prokaryotic plasma membranes.	SCI.9-12.ENE-1.K.3a	MP2
In cellular respiration, electrons delivered by NADH and $FADH_2$ are passed to a series of electron acceptors as they move toward the terminal electron acceptor, oxygen. In photosynthesis, the terminal electron acceptor is $NADP^+$. Aerobic prokaryotes use oxygen as a terminal electron acceptor, while anaerobic prokaryotes use other molecules.	SCI.9-12.ENE-1.K.3b	MP2
The transfer of electrons is accompanied by the formation of a proton gradient across the inner mitochondrial membrane or the internal membrane of chloroplasts, with the membrane(s) separating a region of high proton concentration from a region of low proton concentration. In prokaryotes, the passage of electrons is accompanied by the movement of protons across the plasma membrane.	SCI.9-12.ENE-1.K.3c	MP2
The flow of protons back through membrane-bound ATP synthase by chemiosmosis drives the formation of ATP from ADP and inorganic phosphate. This is known as oxidative phosphorylation in cellular respiration, and photophosphorylation in photosynthesis.	SCI.9-12.ENE-1.K.3d	MP2
In cellular respiration, decoupling oxidative phosphorylation from electron transport generates heat. This heat can be used by endothermic organisms to regulate body temperature.	SCI.9-12.ENE-1.K.3e	MP2
Explain how cells obtain energy from biological macromolecules in order to power cellular functions.	SCI.9-12.ENE-1.L	MP2
Glycolysis is a biochemical pathway that releases energy in glucose to form ATP from ADP and inorganic phosphate, NADH from NAD^+, and pyruvate.	SCI.9-12.ENE-1.L.1	MP2
Pyruvate is transported from the cytosol to the mitochondrion, where further oxidation occurs.	SCI.9-12.ENE-1.L.2	MP2
In the Krebs cycle, carbon dioxide is released from organic intermediates, ATP is synthesized from ADP and inorganic phosphate, and electrons are transferred to the coenzymes NADH and $FADH_2$.	SCI.9-12.ENE-1.L.3	MP2
Electrons extracted in glycolysis and Krebs cycle reactions are transferred by NADH and $FADH_2$ to the electron transport chain in the inner mitochondrial membrane.	SCI.9-12.ENE-1.L.4	MP2
When electrons are transferred between molecules in a sequence of reactions as they pass through the ETC, an electrochemical gradient of protons (hydrogen ions) across the inner mitochondrial membrane is established.	SCI.9-12.ENE-1.L.5	MP2

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Fermentation allows glycolysis to proceed in the absence of oxygen and produces organic molecules, including alcohol and lactic acid, as waste products.	SCI.9-12.ENE-1.L.6	MP2
The conversion of ATP to ADP releases energy, which is used to power many metabolic processes.	SCI.9-12.ENE-1.L.7	MP2
Naturally occurring diversity among and between components within biological systems affects interactions with the environment.	SCI.9-12.SYI-3	MP2
Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments.	SCI.9-12.SYI-3.A	MP2
Variation at the molecular level provides organisms with the ability to respond to a variety of environmental stimuli.	SCI.9-12.SYI-3.A.1	MP2
Variation in the number and types of molecules within cells provides organisms a greater ability to survive and/or reproduce in different environments.	SCI.9-12.SYI-3.A.2	MP2
Cells communicate by generating, transmitting, receiving, and responding to chemical signs.	SCI.9-12.IST-3	MP2
Describe the ways that cells can communicate with one another.	SCI.9-12.IST-3.A	MP2
Cells communicate with one another through direct contact with other cells or from a distance via chemical signaling.	SCI.9-12.IST-3.A.1	MP2
Cells communicate by cell-to-cell contact.	SCI.9-12.IST-3.A.1a	MP2
Explain how cells communicate with one another over short and long distances.	SCI.9-12.IST-3.B	MP2
Cells communicate over short distances by using local regulators that target cells in the vicinity of the signal-emitting cell.	SCI.9-12.IST-3.B.1	MP2
Signals released by one cell type can travel long distances to target cells of another cell type.	SCI.9-12.IST-3.B.1a	MP2
Describe the components of a signal transduction pathway.	SCI.9-12.IST-3.C	MP2
Signal transduction pathways link signal reception with cellular responses.	SCI.9-12.IST-3.C.1	MP2
Many signal transduction pathways include protein modification and phosphorylation cascades.	SCI.9-12.IST-3.C.2	MP2
Describe the role of components of a signal transduction pathway in producing a cellular response.	SCI.9-12.IST-3.D	MP2
Signaling begins with the recognition of a chemical messenger—a ligand—by a receptor protein in a target cell.	SCI.9-12.IST-3.D.1	MP2
The ligand-binding domain of a receptor recognizes a specific chemical messenger, which can be a peptide, a small chemical, or protein, in a specific one-to-one relationship.	SCI.9-12.IST-3.D.1a	MP2
G protein-coupled receptors are an example of a receptor protein in eukaryotes.	SCI.9-12.IST-3.D.1b	MP2

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Signaling cascades relay signals from receptors to cell targets, often amplifying the incoming signals, resulting in the appropriate responses by the cell, which could include cell growth, secretion of molecules, or gene expression.	SCI.9-12.IST-3.D.2	MP2
After the ligand binds, the intracellular domain of a receptor protein changes shape initiating transduction of the signal.	SCI.9-12.IST-3.D.2a	MP2
Second messengers (such as cyclic AMP) are molecules that relay and amplify the intracellular signal.	SCI.9-12.IST-3.D.2b	MP2
Binding of ligand-to-ligand-gated channels can cause the channel to open or close.	SCI.9-12.IST-3.D.2c	MP2
Describe the role of the environment in eliciting a cellular response.	SCI.9-12.IST-3.E	MP2
Signal transduction pathways influence how the cell responds to its environment.	SCI.9-12.IST-3.E.1	MP2
Describe the different types of cellular responses elicited by a signal transduction pathway.	SCI.9-12.IST-3.F	MP2
Signal transduction may result in changes in gene expression and cell function, which may alter phenotype or result in programmed cell death (apoptosis).	SCI.9-12.IST-3.F.1	MP2
Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway.	SCI.9-12.IST-3.G	MP2
Changes in signal transduction pathways can alter cellular response.	SCI.9-12.IST-3.G.1	MP2
Mutations in any domain of the receptor protein or in any component of the signaling pathway may affect the downstream components by altering the subsequent transduction of the signal.	SCI.9-12.IST-3.G.1a	MP2
Chemicals that interfere with any component of the signaling pathway may activate or inhibit the pathway.	SCI.9-12.IST-3.G.2	MP2
Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.	SCI.9-12.ENE-3	MP2
Describe positive and/ or negative feedback mechanisms.	SCI.9-12.ENE-3.A	MP2
Organisms use feedback mechanisms to maintain their internal environments and respond to internal and external environmental changes.	SCI.9-12.ENE-3.A.1	MP2
Explain how negative feedback helps to maintain homeostasis.	SCI.9-12.ENE-3.B	MP2
Negative feedback mechanisms maintain homeostasis for a particular condition by regulating physiological processes. If a system is perturbed, negative feedback mechanisms return the system back to its target set point. These processes operate at the molecular and cellular levels.	SCI.9-12.ENE-3.B.1	MP2
Explain how positive feedback affects homeostasis.	SCI.9-12.ENE-3.C	MP2
Positive feedback mechanisms amplify responses and processes in biological organisms. The variable initiating the response is moved	SCI.9-12.ENE-3.C.1	MP2

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farther away from the initial set point. Amplification occurs when the stimulus is further activated, which, in turn, initiates an additional response that produces system change.		
Describe the events that occur in the cell cycle.	SCI.9-12.IST-1.B	MP2
In eukaryotes, cells divide and transmit genetic information via two highly regulated processes.	SCI.9-12.IST-1.B.1	MP2
The cell cycle is a highly regulated series of events for the growth and reproduction of cells.	SCI.9-12.IST-1.B.2	MP2
The cell cycle consists of sequential stages of interphase (G1, S, G2), mitosis, and cytokinesis.	SCI.9-12.IST-1.B.2a	MP2
A cell can enter a stage (G0) where it no longer divides, but it can reenter the cell cycle in response to appropriate cues. Nondividing cells may exit the cell cycle or be held at a particular stage in the cell cycle.	SCI.9-12.IST-1.B.2b	MP2
Explain how mitosis results in the transmission of chromosomes from one generation to the next.	SCI.9-12.IST-1.C	MP2
Mitosis is a process that ensures the transfer of a complete genome from a parent cell to two genetically identical daughter cells.	SCI.9-12.IST-1.C.1	MP2
Mitosis plays a role in growth, tissue repair, and asexual reproduction.	SCI.9-12.IST-1.C.1a	MP2
Mitosis alternates with interphase in the cell cycle.	SCI.9-12.IST-1.C.1b	MP2
Mitosis occurs in a sequential series of steps (prophase, metaphase, anaphase, telophase).	SCI.9-12.IST-1.C.1c	MP2
Describe the role of checkpoints in regulating the cell cycle.	SCI.9-12.IST-1.D	MP2
A number of internal controls or checkpoints regulate progression through the cycle.	SCI.9-12.IST-1.D.1	MP2
Interactions between cyclins and cyclin- dependent kinases control the cell cycle.	SCI.9-12.IST-1.D.2	MP2
Describe the effects of disruptions to the cell cycle on the cell or organism.	SCI.9-12.IST-1.E	MP2
Disruptions to the cell cycle may result in cancer and/or programmed cell death (apoptosis).	SCI.9-12.IST-1.E.1	MP2
Explain how meiosis results in the transmission of chromosomes from one generation to the next.	SCI.9-12.IST-1.F	MP3
Meiosis is a process that ensures the formation of haploid gamete cells in sexually reproducing diploid organisms.	SCI.9-12.IST-1.F.1	MP3
Meiosis results in daughter cells with half the number of chromosomes of the parent cell.	SCI.9-12.IST-1.F.1a	MP3
Meiosis involves two rounds of a sequential series of steps (meiosis I and meiosis II).	SCI.9-12.IST-1.F.1b	MP3
Describe similarities and/ or differences between the phases and outcomes of mitosis and meiosis.	SCI.9-12.IST-1.G	MP3

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Mitosis and meiosis are similar in the way chromosomes segregate but differ in the number of cells produced and the genetic content of the daughter cells.	SCI.9-12.IST-1.G.1	MP3
Explain how the process of meiosis generates genetic diversity.	SCI.9-12.IST-1.H	MP3
Separation of the homologous chromosomes in meiosis I ensures that each gamete receives a haploid (1n) set of chromosomes that comprises both maternal and paternal chromosomes.	SCI.9-12.IST-1.H.1	MP3
During meiosis I, homologous chromatids exchange genetic material via a process called “crossing over” (recombination), which increases genetic diversity among the resultant gametes.	SCI.9-12.IST-1.H.2	MP3
Sexual reproduction in eukaryotes involving gamete formation — including crossing over, the random assortment of chromosomes during meiosis, and subsequent fertilization of gametes—serves to increase variation.	SCI.9-12.IST-1.H.3	MP3
Organisms are linked by lines of descent from common ancestry.	SCI.9-12.EVO-2	MP3
Explain how shared, conserved, fundamental processes and features support the concept of common ancestry for all organisms.	SCI.9-12.EVO-2.A	MP3
DNA and RNA are carriers of genetic information.	SCI.9-12.EVO-2.A.1	MP3
Ribosomes are found in all forms of life.	SCI.9-12.EVO-2.A.2	MP3
Major features of the genetic code are shared by all modern living systems.	SCI.9-12.EVO-2.A.3	MP3
Core metabolic pathways are conserved across all currently recognized domains.	SCI.9-12.EVO-2.A.4	MP3
Explain the inheritance of genes and traits as described by Mendel’s laws.	SCI.9-12.IST-1.I	MP3
Mendel’s laws of segregation and independent assortment can be applied to genes that are on different chromosomes.	SCI.9-12.IST-1.I.1	MP3
Fertilization involves the fusion of two haploid gametes, restoring the diploid number of chromosomes and increasing genetic variation in populations by creating new combinations of alleles in the zygote.	SCI.9-12.IST-1.I.2	MP3
Rules of probability can be applied to analyze passage of single-gene traits from parent to offspring.	SCI.9-12.IST-1.I.2a	MP3
The pattern of inheritance (monohybrid, dihybrid, sex-linked, and genetically linked genes) can often be predicted from data, including pedigree, which give the parent genotype/phenotype and the offspring genotypes/phenotypes.	SCI.9-12.IST-1.I.2b	MP3
Explain deviations from Mendel’s model of the inheritance of traits.	SCI.9-12.IST-1.J	MP3
Patterns of inheritance of many traits do not follow ratios predicted by Mendel’s laws and can be identified by quantitative analysis, where observed phenotypic ratios statistically differ from the predicted ratios.	SCI.9-12.IST-1.J.1	MP3

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Genes that are adjacent and close to one another on the same chromosome may appear to be genetically linked; the probability that genetically linked genes will segregate as a unit can be used to calculate the map distance between them.	SCI.9-12.IST-1.J.1a	MP3
Some traits are determined by genes on sex chromosomes and are known as sex- linked traits. The pattern of inheritance of sex-linked traits can often be predicted from data, including pedigree, indicating the parent genotype/phenotype and the offspring genotypes/phenotypes.	SCI.9-12.IST-1.J.2	MP3
Many traits are the product of multiple genes and/or physiological processes acting in combination; these traits therefore do not segregate in Mendelian patterns.	SCI.9-12.IST-1.J.3	MP3
Some traits result from non-nuclear inheritance.	SCI.9-12.IST-1.J.4	MP3
Chloroplasts and mitochondria are randomly assorted to gametes and daughter cells; thus, traits determined by chloroplast and mitochondrial DNA do not follow simple Mendelian rules.	SCI.9-12.IST-1.J.4a	MP3
In animals, mitochondria are transmitted by the egg and not by sperm; as such, traits determined by the mitochondrial DNA are maternally inherited.	SCI.9-12.IST-1.J.4b	MP3
In plants, mitochondria and chloroplasts are transmitted in the ovule and not in the pollen; as such, mitochondria-determined and chloroplast-determined traits are maternally inherited.	SCI.9-12.IST-1.J.4c	MP3
Naturally occurring diversity among and between components within biological systems affects interactions with the environment.	SCI.9-12.SYI-3	MP3
Explain how the same genotype can result in multiple phenotypes under different environmental conditions.	SCI.9-12.SYI-3.B	MP3
Environmental factors influence gene expression and can lead to phenotypic plasticity. Phenotypic plasticity occurs when individuals with the same genotype exhibit different phenotypes in different environments.	SCI.9-12.SYI-3.B.1	MP3
Explain how chromosomal inheritance generates genetic variation in sexual reproduction.	SCI.9-12.SYI-3.C	MP3
Segregation, independent assortment of chromosomes, and fertilization result in genetic variation in populations.	SCI.9-12.SYI-3.C.1	MP3
The chromosomal basis of inheritance provides an understanding of the pattern of transmission of genes from parent to offspring.	SCI.9-12.SYI-3.C.2	MP3
Certain human genetic disorders can be attributed to the inheritance of a single affected or mutated allele or specific chromosomal changes, such as nondisjunction.	SCI.9-12.SYI-3.C.3	MP3
Describe the structures involved in passing hereditary information from one generation to the next.	SCI.9-12.IST-1.K	MP3

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DNA, and in some cases RNA, is the primary source of heritable information.	SCI.9-12.IST-1.K.1	MP3
Genetic information is transmitted from one generation to the next through DNA or RNA.	SCI.9-12.IST-1.K.2	MP3
Genetic information is stored in and passed to subsequent generations through DNA molecules and, in some cases, RNA molecules.	SCI.9-12.IST-1.K.2a	MP3
Prokaryotic organisms typically have circular chromosomes, while eukaryotic organisms typically have multiple linear chromosomes.	SCI.9-12.IST-1.K.2b	MP3
Prokaryotes and eukaryotes can contain plasmids, which are small extra-chromosomal, double-stranded, circular DNA molecules.	SCI.9-12.IST-1.K.3	MP3
Describe the characteristics of DNA that allow it to be used as the hereditary material.	SCI.9-12.IST-1.L	MP3
DNA, and sometimes RNA, exhibits specific nucleotide base pairing that is conserved through evolution: adenine pairs with thymine or uracil (A-T or A-U) and cytosine pairs with guanine (C-G).	SCI.9-12.IST-1.L.1	MP3
Purines (G and A) have a double ring structure.	SCI.9-12.IST-1.L.1a	MP3
Pyrimidines (C, T, and U) have a single ring structure.	SCI.9-12.IST-1.L.1b	MP3
Describe the mechanisms by which genetic information is copied for transmission between generations.	SCI.9-12.IST-1.M	MP3
DNA replication ensures continuity of hereditary information.	SCI.9-12.IST-1.M.1	MP3
DNA is synthesized in the 5’ to 3’ direction.	SCI.9-12.IST-1.M.1a	MP3
Replication is a semiconservative process—that is, one strand of DNA serves as the template for a new strand of complementary DNA.	SCI.9-12.IST-1.M.1b	MP3
Helicase unwinds the DNA strands.	SCI.9-12.IST-1.M.1c	MP3
Topoisomerase relaxes supercoiling in front of the replication fork.	SCI.9-12.IST-1.M.1d	MP3
DNA polymerase requires RNA primers to initiate DNA synthesis.	SCI.9-12.IST-1.M.1e	MP3
DNA polymerase synthesizes new strands of DNA continuously on the leading strand and discontinuously on the lagging strand.	SCI.9-12.IST-1.M.1f	MP3
Ligase joins the fragments on the lagging strand.	SCI.9-12.IST-1.M.1g	MP3
Describe the mechanisms by which genetic information flows from DNA to RNA to protein.	SCI.9-12.IST-1.N	MP3
The sequence of the RNA bases, together with the structure of the RNA molecule, determines RNA function.	SCI.9-12.IST-1.N.1	MP3
mRNA molecules carry information from DNA to the ribosome.	SCI.9-12.IST-1.N.1a	MP3
Distinct tRNA molecules bind specific amino acids and have anti-codon sequences that base pair with the mRNA. tRNA is recruited to the ribosome during translation to generate the primary peptide sequence based on the mRNA sequence.	SCI.9-12.IST-1.N.1b	MP3
rRNA molecules are functional building blocks of ribosomes.	SCI.9-12.IST-1.N.1c	MP3

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Genetic information flows from a sequence of nucleotides in DNA to a sequence of bases in an mRNA molecule to a sequence of amino acids in a protein.	SCI.9-12.IST-1.N.2	MP3
RNA polymerases use a single template strand of DNA to direct the inclusion of bases in the newly formed RNA molecule. This process is known as transcription.	SCI.9-12.IST-1.N.3	MP3
The DNA strand acting as the template strand is also referred to as the noncoding strand, minus strand, or antisense strand. Selection of which DNA strand serves as the template strand depends on the gene being transcribed.	SCI.9-12.IST-1.N.4	MP3
The enzyme RNA polymerase synthesizes mRNA molecules in the 5' to 3' direction by reading the template DNA strand in the 3' to 5' direction.	SCI.9-12.IST-1.N.5	MP3
In eukaryotic cells the mRNA transcript undergoes a series of enzyme-regulated modifications.	SCI.9-12.IST-1.N.6	MP3
Addition of a poly-A tail.	SCI.9-12.IST-1.N.6a	MP3
Addition of a GTP cap.	SCI.9-12.IST-1.N.6b	MP3
Excision of introns and splicing and retention of exons.	SCI.9-12.IST-1.N.6c	MP3
Excision of introns and splicing and retention of exons can generate different versions of the resulting mRNA molecule; this is known as alternative splicing.	SCI.9-12.IST-1.N.6d	MP3
Explain how the phenotype of an organism is determined by its genotype.	SCI.9-12.IST.1.O	MP3
Translation of the mRNA to generate a polypeptide occurs on ribosomes that are present in the cytoplasm of both prokaryotic and eukaryotic cells and on the rough endoplasmic reticulum of eukaryotic cells.	SCI.9-12.IST.1.O.1	MP3
In prokaryotic organisms, translation of the mRNA molecule occurs while it is being transcribed.	SCI.9-12.IST.1.O.2	MP3
Translation involves energy and many sequential steps, including initiation, elongation, and termination.	SCI.9-12.IST.1.O.3	MP3
The salient features of translation include:	SCI.9-12.IST.1.O.4	MP3
Translation is initiated when the rRNA in the ribosome interacts with the mRNA at the start codon.	SCI.9-12.IST.1.O.4a	MP3
The sequence of nucleotides on the mRNA is read in triplets called codons.	SCI.9-12.IST.1.O.4b	MP3
Each codon encodes a specific amino acid, which can be deduced by using a genetic code chart. Many amino acids are encoded by more than one codon.	SCI.9-12.IST.1.O.4c	MP3
Nearly all living organisms use the same genetic code, which is evidence for the common ancestry of all living organisms.	SCI.9-12.IST.1.O.4d	MP3

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tRNA brings the correct amino acid to the correct place specified by the codon on the mRNA.	SCI.9-12.IST.1.O.4e	MP3
The amino acid is transferred to the growing polypeptide chain.	SCI.9-12.IST.1.O.4f	MP3
The process continues along the mRNA until a stop codon is reached.	SCI.9-12.IST.1.O.4g	MP3
The process terminates by release of the newly synthesized polypeptide/protein.	SCI.9-12.IST.1.O.4h	MP3
Genetic information in retroviruses is a special case and has an alternate flow of information: from RNA to DNA, made possible by reverse transcriptase, an enzyme that copies the viral RNA genome into DNA. This DNA integrates into the host genome and becomes transcribed and translated for the assembly of new viral progeny.	SCI.9-12.IST.1.O.5	MP3
Differences in the expression of genes account for some of the phenotypic differences between organisms.	SCI.9-12.IST-2	MP3
Describe the types of interactions that regulate gene expression.	SCI.9-12.IST-2.A	MP3
Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription.	SCI.9-12.IST-2.A.1	MP3
Epigenetic changes can affect gene expression through reversible modifications of DNA or histones.	SCI.9-12.IST-2.A.2	MP3
The phenotype of a cell or organism is determined by the combination of genes that are expressed and the levels at which they are expressed.	SCI.9-12.IST-2.A.3	MP3
Observable cell differentiation results from the expression of genes for tissue- specific proteins.	SCI.9-12.IST-2.A.3a	MP3
Induction of transcription factors during development results in sequential gene expression.	SCI.9-12.IST-2.A.3b	MP3
Explain how the location of regulatory sequences relates to their function.	SCI.9-12.IST-2.B	MP3
Both prokaryotes and eukaryotes have groups of genes that are coordinately regulated.	SCI.9-12.IST-2.B.1	MP3
In prokaryotes, groups of genes called operons are transcribed in a single mRNA molecule. The lac operon is an example of and inducible system.	SCI.9-12.IST-2.B.1a	MP3
In eukaryotes, groups of genes may be influenced by the same transcription factors to coordinately regulate expression.	SCI.9-12.IST-2.B.1b	MP3
Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism.	SCI.9-12.IST-2.C	MP3
Promoters are DNA sequences upstream of the transcription start site where RNA polymerase and transcription factors bind to initiate transcription.	SCI.9-12.IST-2.C.1	MP3
Negative regulatory molecules inhibit gene expression by binding to DNA and blocking transcription.	SCI.9-12.IST-2.C.2	MP3

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Explain the connection between the regulation of gene expression and phenotypic differences in cells and organisms.	SCI.9-12.IST-2.D	MP3
Gene regulation results in differential gene expression and influences cell products and function.	SCI.9-12.IST-2.D.1	MP3
Certain small RNA molecules have roles in regulating gene expression.	SCI.9-12.IST-2.D.2	MP3
Describe the various types of mutation.	SCI.9-12.IST-2.E	MP3
Changes in genotype can result in changes in phenotype.	SCI.9-12.IST-2.E.1	MP3
The function and amount of gene products determine the phenotype of organisms.	SCI.9-12.IST-2.E.1a	MP3
The normal function of the genes and gene products collectively comprises the normal function of organisms.	SCI.9-12.IST-2.E.1a.i	MP3
Disruptions in genes and gene products cause new phenotypes.	SCI.9-12.IST-2.E.1a	MP3
Alterations in a DNA sequence can lead to changes in the type or amount of the protein produced and the consequent phenotype. DNA mutations can be positive, negative, or neutral based on the effect or the lack of effect they have on the resulting nucleic acid or protein and the phenotypes that are conferred by the protein.	SCI.9-12.IST-2.E.2	MP3
The processing of genetic information is imperfect and is a source of genetic variation.	SCI.9-12.IST-4	MP3
Explain how changes in genotype may result in changes in phenotype.	SCI.9-12.IST-4.A	MP3
Errors in DNA replication or DNA repair mechanisms, and external factors, including radiation and reactive chemicals, can cause random mutations in the DNA.	SCI.9-12.IST-4.A.1	MP3
Whether a mutation is detrimental, beneficial, or neutral depends on the environmental context.	SCI.9-12.IST-4.A.1a	MP3
Mutations are the primary source of genetic variation.	SCI.9-12.IST-4.A.1b	MP3
Errors in mitosis or meiosis can result in changes in phenotype.	SCI.9-12.IST-4.A.2	MP3
Changes in chromosome number often result in new phenotypes, including sterility caused by triploidy, and increased vigor of other polyploids.	SCI.9-12.IST-4.A.2a	MP3
Changes in chromosome number often result in human disorders with developmental limitations, including Down syndrome/Trisomy 21 and Turner syndrome.	SCI.9-12.IST-4.A.2b	MP3
Explain how alterations in DNA sequences contribute to variation that can be subject to natural selection.	SCI.9-12.IST-4.B	MP3
Changes in genotype may affect phenotypes that are subject to natural selection. Genetic changes that enhance survival and reproduction can be selected for by environmental conditions.	SCI.9-12.IST-4.B.1	MP3
The horizontal acquisitions of genetic information primarily in prokaryotes via transformation (uptake of naked DNA), transduction (viral transmission of genetic information), conjugation (cell-to-cell	SCI.9-12.IST-4.B.1a	MP3

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transfer of DNA), and transposition (movement of DNA segments within and between DNA molecules) increase variation.		
Related viruses can combine/recombine genetic information if they infect the same host cell.	SCI.9-12.IST-4.B.1b	MP3
Reproduction processes that increase genetic variation are evolutionarily conserved and are shared by various organisms.	SCI.9-12.IST-4.B.1c	MP3
Explain the use of genetic engineering techniques in analyzing or manipulating DNA.	SCI.9-12.IST-1.P	MP3
Genetic engineering techniques can be used to analyze and manipulate DNA and RNA.	SCI.9-12.IST-1.P.1	MP3
Electrophoresis separates molecules according to size and charge.	SCI.9-12.IST-1.P.1a	MP3
During polymerase chain reaction (PCR), DNA fragments are amplified.	SCI.9-12.IST-1.P.1b	MP3
Bacterial transformation introduces DNA into bacterial cells.	SCI.9-12.IST-1.P.1c	MP3
DNA sequencing determines the order of nucleotides in a DNA molecule.	SCI.9-12.IST-1.P.1d	MP3
Describe the causes of natural selection.	SCI.9-12.EVO-1.C	MP4
Natural selection is a major mechanism of evolution.	SCI.9-12.EVO-1.C.1	MP4
According to Darwin's theory of natural selection, competition for limited resources results in differential survival. Individuals with more favorable phenotypes are more likely to survive and produce more offspring, thus passing traits to subsequent generations.	SCI.9-12.EVO-1.C.2	MP4
Explain how natural selection affects populations.	SCI.9-12.EVO-1.D	MP4
Evolutionary fitness is measured by reproductive success.	SCI.9-12.EVO-1.D.1	MP4
Biotic and abiotic environments can be more or less stable/fluctuating, and this affects the rate and direction of evolution; different genetic variations can be selected in each generation.	SCI.9-12.EVO-1.D.2	MP4
Describe the importance of phenotypic variation in a population.	SCI.9-12.EVO-1.E	MP4
Natural selection acts on phenotypic variations in populations.	SCI.9-12.EVO-1.E.1	MP4
Environments change and apply selective pressures to populations.	SCI.9-12.EVO-1.E.2	MP4
Some phenotypic variations significantly increase or decrease fitness of the organism in particular environments.	SCI.9-12.EVO-1.E.3	MP4
Explain how humans can affect diversity within a population.	SCI.9-12.EVO-1.F	MP4
Through artificial selection, humans affect variation in other species.	SCI.9-12.EVO-1.F.1	MP4
Explain the relationship between changes in the environment and evolutionary changes in the population.	SCI.9-12.EVO-1.G	MP4
Convergent evolution occurs when similar selective pressures result in similar phenotypic adaptations in different populations or species.	SCI.9-12.EVO-1.G.1	MP4
Explain how random occurrences affect the genetic makeup of a population.	SCI.9-12.EVO-1.H	MP4
Evolution is also driven by random occurrences.	SCI.9-12.EVO-1.H.1	MP4
Mutation is a random process that contributes to evolution.	SCI.9-12.EVO-1.H.1a	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
Genetic drift is a nonselective process occurring in small populations.	SCI.9-12.EVO-1.H.1b	MP4
Migration/gene flow can drive evolution.	SCI.9-12.EVO-1.H.1c	MP4
Describe the role of random processes in the evolution of specific populations.	SCI.9-12.EVO-1.I	MP4
Reduction of genetic variation within a given population can increase the differences between populations of the same species.	SCI.9-12.EVO-1.I.1	MP4
Describe the change in the genetic makeup of a population over time.	SCI.9-12.EVO-1.J	MP4
Mutation results in genetic variation, which provides phenotypes on which natural selection acts.	SCI.9-12.EVO-1.J.1	MP4
Describe the conditions under which allele and genotype frequencies will change in populations.	SCI.9-12.EVO-1.K	MP4
Hardy-Weinberg is a model for describing and predicting allele frequencies in a nonevolving population. Conditions for a population or an allele to be in Hardy-Weinberg equilibrium are—(1) a large population size, (2) absence of migration, (3) no net mutations, (4) random mating, and (5) absence of selection. These conditions are seldom met, but they provide a valuable null hypothesis.	SCI.9-12.EVO-1.K.1	MP4
Allele frequencies in a population can be calculated from genotype frequencies.	SCI.9-12.EVO-1.K.2	MP4
Explain the impacts on the population if any of the conditions of Hardy-Weinberg are not met.	SCI.9-12.EVO-1.L	MP4
Changes in allele frequencies provide evidence for the occurrence of evolution in a population.	SCI.9-12.EVO-1.L.1	MP4
Small populations are more susceptible to random environmental impact than large populations.	SCI.9-12.EVO-1.L.2	MP4
Describe the types of data that provide evidence for evolution.	SCI.9-12.EVO-1.M	MP4
Evolution is supported by scientific evidence from many disciplines (geographical, geological, physical, biochemical, and mathematical data).	SCI.9-12.EVO-1.M.1	MP4
Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time.	SCI.9-12.EVO-1.N	MP4
Molecular, morphological, and genetic evidence from extant and extinct organisms adds to our understanding of evolution.	SCI.9-12.EVO-1.N.1	MP4
Fossils can be dated by a variety of methods.	SCI.9-12.EVO-1.N.1a	MP4
Morphological homologies, including vestigial structures, represent features shared by common ancestry.	SCI.9-12.EVO-1.N.1b	MP4
A comparison of DNA nucleotide sequences and/or protein amino acid sequences provides evidence for evolution and common ancestry.	SCI.9-12.EVO-1.N.2	MP4
Describe the fundamental molecular and cellular features shared across all domains of life, which provide evidence of common ancestry.	SCI.9-12.EVO-2.B	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
Many fundamental molecular and cellular features and processes are conserved across organisms.	SCI.9-12.EVO-2.B.1	MP4
Structural and functional evidence supports the relatedness of organisms in all domains.	SCI.9-12.EVO-2.B.2	MP4
Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes.	SCI.9-12.EVO-2.C	MP4
Structural evidence indicates common ancestry of all eukaryotes.	SCI.9-12.EVO-2.C.1	MP4
Life continues to evolve within a changing environment.	SCI.9-12.EVO-3	MP4
Explain how evolution is an ongoing process in all living organisms.	SCI.9-12.EVO-3.A	MP4
Populations of organisms continue to evolve.	SCI.9-12.EVO-3.A.1	MP4
All species have evolved and continue to evolve.	SCI.9-12.EVO-3.A.2	MP4
Genomic changes over time.	SCI.9-12.EVO-3.A.2a	MP4
Continuous change in the fossil record.	SCI.9-12.EVO-3.A.2b	MP4
Evolution of resistance to antibiotics, pesticides, herbicides, or chemotherapy drugs.	SCI.9-12.EVO-3.A.2c	MP4
Pathogens evolve and cause emergent diseases.	SCI.9-12.EVO-3.A.2d	MP4
Describe the types of evidence that can be used to infer an evolutionary relationship.	SCI.9-12.EVO-3.B	MP4
Phylogenetic trees and cladograms show evolutionary relationships among lineages.	SCI.9-12.EVO-3.B.1	MP4
Phylogenetic trees and cladograms both show relationships between lineages, but phylogenetic trees show the amount of change over time calibrated by fossils or a molecular clock.	SCI.9-12.EVO-3.B.1a	MP4
Traits that are either gained or lost during evolution can be used to construct phylogenetic trees and cladograms.	SCI.9-12.EVO-3.B.1b	MP4
Shared characters are present in more than one lineage.	SCI.9-12.EVO-3.B.1b.i	MP4
Shared, derived characters indicate common ancestry and are informative for the construction of phylogenetic trees and cladograms.	SCI.9-12.EVO-3.B.1b.ii	MP4
The out-group represents the lineage that is least closely related to the remainder of the organisms in the phylogenetic tree or cladogram.	SCI.9-12.EVO-3.B.1b.iii	MP4
Molecular data typically provide more accurate and reliable evidence than morphological traits in the construction of phylogenetic trees or cladograms.	SCI.9-12.EVO-3.B.1c	MP4
Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness.	SCI.9-12.EVO-3.C	MP4
Phylogenetic trees and cladograms can be used to illustrate speciation that has occurred. The nodes on a tree represent the most recent common ancestor of any two groups or lineages.	SCI.9-12.EVO-3.C.1	MP4

Performance Indicator	**College Board Advanced Placement Program Standards**	**Marking Period Taught**
Phylogenetic trees and cladograms can be constructed from morphological similarities of living or fossil species and from DNA and protein sequence similarities.	SCI.9-12.EVO-3.C.2	MP4
Phylogenetic trees and cladograms represent hypotheses and are constantly being revised, based on evidence.	SCI.9-12.EVO-3.C.3	MP4
Describe the conditions under which new species may arise.	SCI.9-12.EVO-3.D	MP4
Speciation may occur when two populations become reproductively isolated from each other.	SCI.9-12.EVO-3.D.1	MP4
The biological species concept provides a commonly used definition of species for sexually reproducing organisms. It states that species can be defined as a group capable of interbreeding and exchanging genetic information to produce viable, fertile offspring.	SCI.9-12.EVO-3.D.2	MP4
Describe the rate of evolution and speciation under different ecological conditions.	SCI.9-12.EVO-3.E	MP4
Punctuated equilibrium is when evolution occurs rapidly after a long period of stasis. Gradualism is when evolution occurs slowly over hundreds of thousands or millions of years.	SCI.9-12.EVO-3.E.1	MP4
Divergent evolution occurs when adaptation to new habitats results in phenotypic diversification. Speciation rates can be especially rapid during times of adaptive radiation as new habitats become available.	SCI.9-12.EVO-3.E.2	MP4
Explain the processes and mechanisms that drive speciation.	SCI.9-12.EVO-3.F	MP4
Speciation results in diversity of life forms.	SCI.9-12.EVO-3.F.1	MP4
Speciation may be sympatric or allopatric.	SCI.9-12.EVO-3.F.2	MP4
Various prezygotic and postzygotic mechanisms can maintain reproductive isolation and prevent gene flow between populations.	SCI.9-12.EVO-3.F.3	MP4
Describe factors that lead to the extinction of a population.	SCI.9-12.EVO-3.G	MP4
Extinctions have occurred throughout Earth's history.	SCI.9-12.EVO-3.G.1	MP4
Extinction rates can be rapid during times of ecological stress.	SCI.9-12.EVO-3.G.2	MP4
Explain how the risk of extinction is affected by changes in the environment.	SCI.9-12.EVO-3.H	MP4
Human activity can drive changes in ecosystems that cause extinctions.	SCI.9-12.EVO-3.H.1	MP4
Explain species diversity in an ecosystem as a function of speciation and extinction rates.	SCI.9-12.EVO-3.I	MP4
The amount of diversity in an ecosystem can be determined by the rate of speciation and the rate of extinction.	SCI.9-12.EVO-3.I.1	MP4
Explain how extinction can make new environments available for adaptive radiation.	SCI.9-12.EVO-3.J	MP4
Extinction provides newly available niches that can then be exploited by different species.	SCI.9-12.EVO-3.J.1	MP4
Naturally occurring diversity among and between components within biological systems affects interactions with the environment.	SCI.9-12.SYI-3	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures.	SCI.9-12.SYI-3.D	MP4
The level of variation in a population affects population dynamics.	SCI.9-12.SYI-3.D.1	MP4
Population ability to respond to changes in the environment is influenced by genetic diversity. Species and populations with little genetic diversity are at risk of decline or extinction.	SCI.9-12.SYI-3.D.1a	MP4
Genetically diverse populations are more resilient to environmental perturbation because they are more likely to contain individuals who can withstand the environmental pressure.	SCI.9-12.SYI-3.D.1b	MP4
Alleles that are adaptive in one environmental condition may be deleterious in another because of different selective pressures.	SCI.9-12.SYI-3.D.1c	MP4
Describe the scientific evidence that provides support for models of the origin of life on Earth.	SCI.9-12.SYI-3.E	MP4
Several hypotheses about the origin of life on Earth are supported with scientific evidence.	SCI.9-12.SYI-3.E.1	MP4
Geological evidence provides support for models of the origin of life on Earth.	SCI.9-12.SYI-3.E.1a	MP4
Earth formed approximately 4.6 billion years ago (bya). The environment was too hostile for life until 3.9 bya, and the earliest fossil evidence for life dates to 3.5 bya. Taken together, this evidence provides a plausible range of dates when the origin of life could have occurred.	SCI.9-12.SYI-3.E.1a.i	MP4
There are several models about the origin of life on Earth.	SCI.9-12.SYI-3.E.1b	MP4
Primitive Earth provided inorganic precursors from which organic molecules could have been synthesized because of the presence of available free energy and the absence of a significant quantity of atmospheric oxygen (O_2).	SCI.9-12.SYI-3.E.1b.i	MP4
Organic molecules could have been transported to Earth by a meteorite or other celestial event.	SCI.9-12.SYI-3.E.1b.ii	MP4
Chemical experiments have shown that it is possible to form complex organic molecules from inorganic molecules in the absence of life.	SCI.9-12.SYI-3.E.1c	MP4
Organic molecules/monomers served as building blocks for the formation of more complex molecules, including amino acids and nucleotides.	SCI.9-12.SYI-3.E.1c.i	MP4
The joining of these monomers produced polymers with the ability to replicate, store, and transfer information.	SCI.9-12.SYI-3.E.1c.ii	MP4
The RNA World Hypothesis proposes that RNA could have been the earliest genetic material.	SCI.9-12.SYI-3.E.2	MP4
Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.	SCI.9-12.ENE-3.D	MP4
Organisms respond to changes in their environment through behavioral and physiological mechanisms.	SCI.9-12.ENE-3.D.1	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
Organisms exchange information with one another in response to internal changes and external cues, which can change behavior.	SCI.9-12.ENE-3.D.2	MP4
Transmission of information results in changes within and between biological systems.	SCI.9-12.ENE-5	MP4
Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.	SCI.9-12.ENE-5.A	MP4
Individuals can act on information and communicate it to others.	SCI.9-12.ENE-5.A.1	MP4
Communication occurs through various mechanisms.	SCI.9-12.ENE-5.A.2	MP4
Organisms have a variety of signaling behaviors that produce changes in the behavior of other organisms and can result in differential reproductive success.	SCI.9-12.ENE-5.A.2a	MP4
Animals use visual, audible, tactile, electrical, and chemical signals to indicate dominance, find food, establish territory, and ensure reproductive success.	SCI.9-12.ENE-5.A.2b	MP4
Responses to information and communication of information are vital to natural selection and evolution.	SCI.9-12.ENE-5.A.3	MP4
Natural selection favors innate and learned behaviors that increase survival and reproductive fitness.	SCI.9-12.ENE-5.A.3a	MP4
Cooperative behavior tends to increase the fitness of the individual and the survival of the population.	SCI.9-12.ENE-5.A.3b	MP4
Describe the strategies organisms use to acquire and use energy.	SCI.9-12.ENE-1.M	MP4
Organisms use energy to maintain organization, grow, and reproduce.	SCI.9-12.ENE-1.M.1	MP4
Organisms use different strategies to regulate body temperature and metabolism.	SCI.9-12.ENE-1.M.1a	MP4
Endotherms use thermal energy generated by metabolism to maintain homeostatic body temperatures.	SCI.9-12.ENE-1.M.1a.i	MP4
Ectotherms lack efficient internal mechanisms for maintaining body temperature, though they may regulate their temperature behaviorally by moving into the sun or shade or by aggregating with other individuals.	SCI.9-12.ENE-1.M.1a.ii	MP4
Different organisms use various reproductive strategies in response to energy availability.	SCI.9-12.ENE-1.M.1b	MP4
There is a relationship between metabolic rate per unit body mass and the size of multicellular organisms—generally, the smaller the organism, the higher the metabolic rate.	SCI.9-12.ENE-1.M.1c	MP4
A net gain in energy results in energy storage or the growth of an organism.	SCI.9-12.ENE-1.M.1d	MP4
A net loss of energy results in loss of mass and, ultimately, the death of an organism.	SCI.9-12.ENE-1.M.1e	MP4
Explain how changes in energy availability affect populations and ecosystems.	SCI.9-12.ENE-1.N	MP4
Changes in energy availability can result in changes in population size.	SCI.9-12.ENE-1.N.1	MP4

Performance Indicator	**College Board Advanced Placement Program Standards**	**Marking Period Taught**
Changes in energy availability can result in disruptions to an ecosystem.	SCI.9-12.ENE-1.N.2	MP4
A change in energy resources such as sunlight can affect the number and size of the trophic levels.	SCI.9-12.ENE-1.N.2a	MP4
A change in the producer level can affect the number and size of other trophic levels.	SCI.9-12.ENE-1.N.2b	MP4
Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.	SCI.9-12.ENE-1.O	MP4
Autotrophs capture energy from physical or chemical sources in the environment.	SCI.9-12.ENE-1.O.1	MP4
Photosynthetic organisms capture energy present in sunlight.	SCI.9-12.ENE-1.O.1a	MP4
Chemosynthetic organisms capture energy from small inorganic molecules present in their environment, and this process can occur in the absence of oxygen.	SCI.9-12.ENE-1.O.1b	MP4
Heterotrophs capture energy present in carbon compounds produced by other organisms.	SCI.9-12.ENE.1.O.2	MP4
Heterotrophs may metabolize carbohydrates, lipids, and proteins as sources of energy by hydrolysis.	SCI.9-12.ENE-1.O.2a	MP4
Describe factors that influence growth dynamics of populations.	SCI.9-12.SYI-1.G	MP4
Populations comprise individual organisms that interact with one another and with the environment in complex ways.	SCI.9-12.SYI-1.G.1	MP4
Many adaptations in organisms are related to obtaining and using energy and matter in a particular environment.	SCI.9-12.SYI-1.G.2	MP4
Population growth dynamics depend on a number of factors.	SCI.9-12.SYI-1.G.2a	MP4
Reproduction without constraints results in the exponential growth of a population.	SCI.9-12.SYI-1.G.2a.i	MP4
Explain how the density of a population affects and is determined by resource availability in the environment.	SCI.9-12.SYI-1.H	MP4
A population can produce a density of individuals that exceeds the system's resource availability.	SCI.9-12.SYI-1.H.1	MP4
As limits to growth due to density-dependent and density-independent factors are imposed, a logistic growth model generally ensues.	SCI.9-12.SYI-1.H.2	MP4
Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.	SCI.9-12.ENE-4	MP4
Describe the structure of a community according to its species composition and diversity.	SCI.9-12.ENE-4.A	MP4
The structure of a community is measured and described in terms of species composition and species diversity.	SCI.9-12.ENE-4.A.1	MP4
Explain how interactions within and among populations influence community structure.	SCI.9-12.ENE-4.B	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
Communities change over time depending on interactions between populations.	SCI.9-12.ENE-4.B.1	MP4
Interactions among populations determine how they access energy and matter within a community.	SCI.9-12.ENE-4.B.2	MP4
Relationships among interacting populations can be characterized by positive and negative effects and can be modeled. Examples include predator/prey interactions, trophic cascades, and niche partitioning.	SCI.9-12.ENE-4.B.3	MP4
Competition, predation, and symbioses, including parasitism, mutualism, and commensalism, can drive population dynamics.	SCI.9-12.ENE-4.B.4	MP4
Explain how community structure is related to energy availability in the environment.	SCI.9-12.ENE-4.C	MP4
Cooperation or coordination between organisms, populations, and species can result in enhanced movement of, or access to, matter and energy.	SCI.9-12.ENE-4.C.1	MP4
Describe the relationship between ecosystem diversity and its resilience to changes in the environment.	SCI.9-12.SYI-3.F	MP4
Natural and artificial ecosystems with fewer component parts and with little diversity among the parts are often less resilient to changes in the environment.	SCI.9-12.SYI-3.F.1	MP4
Keystone species, producers, and essential abiotic and biotic factors contribute to maintaining the diversity of an ecosystem.	SCI.9-12.SYI-3.F.2	MP4
Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long- term structure.	SCI.9-12.SYI-3.G	MP4
The diversity of species within an ecosystem may influence the organization of the ecosystem.	SCI.9-12.SYI-3.G.1	MP4
The effects of keystone species on the ecosystem are disproportionate relative to their abundance in the ecosystem, and when they are removed from the ecosystem, the ecosystem often collapses.	SCI.9-12.SYI-3.G.2	MP4
Explain the interaction between the environment and random or preexisting variations in populations.	SCI.9-12.EVO-1.O	MP4
An adaptation is a genetic variation that is favored by selection and is manifested as a trait that provides an advantage to an organism in a particular environment.	SCI.9-12.EVO-1.O.1	MP4
Mutations are random and are not directed by specific environmental pressures. Competition and cooperation are important aspects of biological systems.	SCI.9-12.EVO-1.O.2	MP4
Competition and cooperation are important aspects of biological systems.	SCI.9-12.SYI-2	MP4
Explain how invasive species affect ecosystem dynamics.	SCI.9-12.SYI-2.A	MP4

Performance Indicator	College Board Advanced Placement Program Standards	Marking Period Taught
The intentional or unintentional introduction of an invasive species can allow the species to exploit a new niche free of predators or competitors or to outcompete other organisms for resources.	SCI.9-12.SYI-2.A.1	MP4
The availability of resources can result in uncontrolled population growth and ecological changes.	SCI.9-12.SYI-2.A.2	MP4
Describe human activities that lead to changes in ecosystem structure and/ or dynamics.	SCI.9-12.SYI-2.B	MP4
The distribution of local and global ecosystems changes over time.	SCI.9-12.SYI-2.B.1	MP4
Human impact accelerates change at local and global levels.	SCI.9-12.SYI-2.B.2	MP4
The introduction of new diseases can devastate native species.	SCI.9-12.SYI-2.B.2a	MP4
Habitat change can occur because of human activity.	SCI.9-12.SYI-2.B.2b	MP4
Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.	SCI.9-12.SYI-2.C	MP4
Geological and meteorological events affect habitat change and ecosystem distribution. Biogeographical studies illustrate these changes.	SCI.9-12.SYI-2.C.1	MP4

ASSESSMENTS:

PDE Academic Standards, Assessment Anchors, and Eligible Content: The teacher must be knowledgeable of the PDE Academic Standards, Assessment Anchors, and Eligible Content and incorporate them regularly into planned instruction.

Formative Assessments: The teacher will utilize a variety of assessment methods to conduct in-process evaluations of student learning.

Effective formative assessments for this course include: Bell ringers, exit tickets, notice and wonderings, progress checks, quizzes, lab assignments, teacher questioning, class discussions, peer assessments, and model trackers.

Summative Assessments: The teacher will utilize a variety of assessment methods to evaluate student learning at the end of an instructional task, lesson, and/or unit.

Effective summative assessments for this course include: Lab reports, CER responses, chapter tests, district marking period assessments, culminating tasks, and projects.