Date: **High School**

El Monte Union High School District

Course Outline

Course Title: Biology Pre-AP

Textbook(s): Campbell Biology
Concepts and connections Reece,
:
Copyright date/Edition:

Transitional*_____(Eng. Dept. Only)

Sheltered (SDAIE)*____Bilingual*___

AP** Honors**

Department:

CTE***:
Industry Sector: _____

Pathway:
(check one)
___Intro ___ Intermediate
__Capstone

Grade Level (s): 9

Semester Year X

Year of State Framework Adoption_____

This course meets graduation requirements:

( ) English
( ) Fine Arts
( ) World Language
( ) Health & Safety
( ) Math
( ) Physical Education
(X) Science
( ) Social Science
( ) Elective

This course meets a-g requirements:
(_____) "a" – Social Studies
(_____) "b" – ELA
(_____) "c" – Math
(_____) "d" – Lab Science
(____) "e" – Language (not English)
(_____) "f" – Vis/Perf Arts
(_____) "g" – College prep elective

Department/Cluster Approval	Date
_____	_____
_____	_____
_____	_____
_____	_____
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_____	_____

Is this course an adaptation from another source?
(___) No
(__X___) Yes
If yes, please indicate the source of the original course: UCOP approved course outline.

*Instructional materials appropriate for English Language Learners are required.

**For AP/Honors course attach a page describing how this course is above and beyond a regular course. Also, explain why this course is the equivalent of a college level class.
***For CTE, attach the CTE course outline created in the online template (http://ctecourse.scoe.net/).

1. Prerequisite(s): None

2. Short description of course which may also be used in the registration manual:

Course overview:

The BASIS Pre-AP (honors) biology course includes the scientific process and knowledge of the hierarchy of life. Also scientific method and experimental design are included. Atoms, elements, compounds and chemical bonds are discussed. Water's life supporting properties and the knowledge of chemical bonds builds on the topics of macromolecules of life, organic compounds, carbohydrates, proteins, lipids, nucleic acids and proteins. There is a unit on cells with special focus on energy converting organelles. Cellular respiration and photosynthesis are discussed. The course includes cellular transport mechanisms, the role of enzymes and chemical reactions in cells. The role of the balance between exergonic and endergonic reactions in sustaining life is included. The course includes discussion on asexual and sexual reproduction. Cell division is studied in detail with both mitosis and meiosis and their significance. After cell division the course discusses Heredity and genetics in detail with Mendelian genetics and non-Mendelian genetics with sufficient examples. Structure and replication of DNA and genes and gene expression are included. The processes of transcription and translation are studied in detail. The genetics of viruses and bacteria is discussed. Gene expression and its regulation, cloning of plants and animals and genetic basis of cancer are studied. The knowledge of genes and heredity leads into the process of evolution. Darwin's theory of natural selection, evolution of populations and microevolution are discussed. Species and mechanisms of speciation are discussed. Origin of life, major events, macroevolution and phylogeny are discussed. Classification is discussed. The course includes body organization and some major organ systems like the endocrine, muscular, immune and nervous systems. Also some major modern biotechnology techniques are included.

Elementary algebra is a prerequisite for the course. Quantitative methods and reasoning are used wherever appropriate in several chapters across the curriculum.

Course content:
Course Purpose

The Pre-AP (honors) biology course is designed to gain moderate in-depth knowledge of a wide range of biology topics. The lessons on scientific process and knowledge of the hierarchy of life with a focus on the scientific method and experimental design should have students prepared for using the scientific method in all aspects of life with the ability to plan an experiment, understand and interpret data. Scientific logic and its application are the goals.

The course moves on to establishing student understanding of atoms, elements and compounds. How chemical bonds are formed and their major types. Water's life supporting properties are discussed in detail so they can see their application in real life context. The knowledge of chemical bonds builds on to learning about the macromolecules of life, organic compounds, carbohydrates, proteins, lipids, nucleic acids and proteins. The goal is to enable students to understand the structure and function of the building blocks of life.

The next unit on cells extends to learning about the smallest unit of life- the cell and its major organelles. A special focus on energy converting organelles builds the foundation for discussing cellular respiration and photosynthesis in great detail. The student outcome focuses on understanding at the molecular level how all food is produced on earth and that plants are at the base of the ecological pyramid. Cellular respiration is studied in detail in both prokaryotes and eukaryotes. How the process works in presence and absence of oxygen is discussed. The students also understand at the molecular level how respiration and conversion of food into energy work at the level of cells. Finally the goal for students is to understand the link between these two processes of

cellular respiration and photosynthesis for sustenance of life. The course discusses cellular transport mechanisms, the role of enzymes and chemical reactions in cells. The student outcome is to understand the role of the balance between exergonic and endergonic reactions in sustaining life.

The course discusses asexual and sexual reproduction. Cell division is studied in detail with both mitosis and meiosis and their significance. The students should be able to explain the role of mitosis and meiosis in growth and development and be able to visualize it with respect to themselves. After cell division the course discusses Heredity and genetics in detail with Mendelian genetics and non-Mendelian genetics with sufficient examples. The students are able to predict genotypes and phenotypes. They can assess genotypes on pedigree charts based on dominant and recessive allele based characteristics as well as for sex-linked diseases.

The students learn about the discovery, structure and replication of DNA. Genes and gene expression are studied. The processes of transcription and translation are studied in detail. The students are able to understand the role of gene expression in tissue specialization and structure. How errors in gene expression can be disruptive and lead to several life threatening disorders. The genetics of viruses and bacteria is discussed. The goal is to understand their role in diseases and their application for experiments.

The lessons on cloning of plants and animals arm the students with a realistic understanding of how cloning is actually done and the associated challenges. The students can also distinguish between plant and animal cloning. The in depth study of the genetic basis of cancer is geared to make students understand the molecular basis of cancer, the genes involved, the time course of disease, the risk factors and possible treatment methods.

The knowledge of genes and heredity leads into the process of evolution. Darwin's theory of natural selection, evolution of populations and microevolution are discussed. Species and mechanisms of speciation are discussed. Origin of life, major events, macroevolution and phylogeny are discussed. The goal for students is to understand the evolution of life billions of years ago and trace evolutionary history until present day forms. Also students understand how evolution happens at the micro and macro levels. The students learn to read a phylogenetic tree and look for common ancestors. Classification is discussed. The students understand the organization of living organisms of all complexity. Lastly body organization and some major organ systems like the Endocrine, Immune and nervous systems are studied. The students understand the process of homeostasis, the coordination of organ systems and learn in depth about a few organ systems like the Endocrine, Immune and nervous systems. The students can associate their learning with their own bodies and physiology. We also discuss some major modern biotechnology techniques. The achievement goal is for students to understand the modern techniques of DNA manipulation and how they work at the technical level. The students should be able to visualize the macromolecules of life in their molecular form.

Unit 1: Life of a cell

The first unit, life of the cell discusses the concepts of scientific method, unifying concepts of life, chemical basis of life, the major macromolecules making all living beings, the structure of the cell and mechanisms used by cells to harvest energy.

Chapter 1- Scientific Process

The word *science* is derived from a Latin verb meaning "to know." Science is a way of knowing. Students are taught the importance of having a scientific temper and how scientists use inductive reasoning to draw general conclusions from many observations. The concept of hypothesis is taught. Practical examples are used to help students come up with a hypothesis of their

own. The students are taught deductive reasoning. Another important concept is the development of a theory. This is simplified for the students using the popular cell theory as an example which is also part of their curriculum. Scientific Method is the heart of science and is essential for developing curiosity and analyzing available information. This chapter also deals with the methodology of scientific investigation. The steps of the method are explained to students using the key steps of observation, inference, hypothesis, controlled experiment, independent variable, dependent variable, control group and data. The students are given several experimental examples and real life situations to understand the steps and explain them scientifically following the method. The students are also taught to interpret and draw graphs of data. Data collection methods are reviewed with the students. The students are taught the importance of reporting accurate results and writing peer-reviewed publications. Testing for the chapter involves some multiple choice, short answers to define terms and experimental scenarios where they are asked to identify the different variables and interpret data and design experiments. The students are also taught the importance of basic biological connections between organisms, evolution, and hierarchy of life and how organisms interact with their environment. This chapter sets the background for beginning the course.

The core text book, Reece et al., chapter 1, “Biology: Exploring Life” is the text reference. Particular emphasis is on section 1.8 and 1.9 on the process of science. Some experiments are teacher designed for practicing scientific methodology by creating experimental scenarios including control and experimental groups and several variables.

Chapter 2- The chemical Basis of Life

This chapter focusses on elements, atoms and compounds. Chemical bonds and water’s life-supporting properties are discussed in depth. Living organisms are composed of matter, which is anything that occupies space and has mass (weight). The concepts of element, compound, and emergent properties are explained in detail. The importance of abundant and trace elements is also studied. Iodine and fluoride are discussed with respect to thyroid and dental health. Atoms, their structure, atomic particles, charges, and the electrons involved in chemical bonding is a focus. Isotopes and their practical applications are discussed. Covalent bonds, both polar and non-polar are discussed. Ionic bonds, Vander walls forces, and hydrogen bonds are studied in depth. The role of hydrogen bonding in contributing to the unique properties of water like surface tension is discussed. Practical examples like water, ice density, surfing, insects floating on water are used to explain hydrogen bonding. Several daily life observations are used to make concepts simpler for students to understand particularly for the properties of water. The concepts of cohesion and adhesion are explained and associated to examples of plants and gecko crawling on walls. The concepts of solutions, solute, solvent, aqueous solution are discussed. The pH scale, acidity, basicity, buffers, are taught with examples of daily household chemicals. The chapter also discusses important phenomena which impact the environment like acid precipitation and acid rain and its impact on marine life.

The text book Reece et al., Unit 1, chapter 2, “The chemical basis of life” is followed. All the sections of this chapter are discussed.

Chapter 3- Classes of Macromolecules

The understanding of chemical bonds in details prepares the students for understanding complex molecular structures which build life. This chapter focusses on organic compounds. Carbohydrates, proteins, lipids and nucleic acids and their functions are discussed in detail. Their structure and chemical bonds, importance to living things and other important properties are discussed. The students are able to describe the importance of carbon in life’s molecular diversity. The chemical groups that are important to life are discussed. The chapter discusses how a cell can make a variety of large molecules from a small set of molecules. The students understand the concepts of monosaccharides, disaccharides, and polysaccharides and are able to explain their functions. Lipids, phospholipids, and steroids and their functions are discussed in depth. The chemical structure of proteins and their

importance to cells are taught in detail. The students develop in depth understanding of the chemical structure of nucleic acids and how they relate to inheritance. The phenomenon of lactose tolerance and its evolution in humans is discussed.

The text book Reece et al., Unit 1, chapter 3, “The molecules of the cell” is followed. The entire chapter is done in detail.

Chapter 4- Cell Structure and Function

This chapter focuses on the Prokaryotic and eukaryotic cell, organelles and their functions. The students are able to describe the importance of microscopes in understanding cell structure and function. They are able to describe the two parts of the cell theory. They gain the knowledge to be able to distinguish between the structures of prokaryotic and eukaryotic cells. Student understanding of how cell size is limited is gained. The students are able to describe the structure and functions of cell membranes and explain why compartmentalization is important in eukaryotic cells. They are able to compare the structures of plant and animal cells. The students understand the function of each cell part. They are able to compare the structures and functions of chloroplasts and mitochondria. Student understanding of the evidence that suggests that mitochondria and chloroplasts evolved by endosymbiosis helps them to link ancient life to the present cells. The students are able to compare the structures and functions of microfilaments, intermediate filaments, and microtubules. The ability to relate the structure of cilia and flagella to their functions helps student understanding of structure to function. The structure of the extracellular matrix to its functions is understood. The comparison of the structures and functions of tight junctions, anchoring junctions, and gap junctions, plant cell walls and plasmodesmata is done in detail. The students are able to classify the four functional categories of organelles in eukaryotic cells.

The text book Reece et al., unit 1, chapter 4, “A tour of the cell” is followed. The entire chapter is done in detail. The students prepare animal (cheek cells) and plant cells (onion peel) wet mounts and see them under the microscope and distinguish them.

Chapter 5- Cellular Exchange with the Environment

This chapter describes the fluid mosaic structure of cell membranes. The emphasis is on the diverse functions of membrane proteins. The students are able to relate the structure of phospholipid molecules to the structure and properties of cell membranes. They are able to define diffusion and describe the process of passive transport. The students gain in depth understanding of how osmosis can be defined as the diffusion of water across a membrane. They are able to distinguish between hypertonic, hypotonic, and isotonic solutions and explain how transport proteins facilitate diffusion. The concepts of exocytosis, endocytosis, phagocytosis, pinocytosis, and receptor-mediated endocytosis are discussed in detail. The students are able to define and compare kinetic energy, potential energy, chemical energy, and heat. They study the two laws of thermodynamics and explain how they relate to biological systems. The students are able to define and compare endergonic and exergonic reactions. They can explain how cells use cellular respiration and energy coupling to survive. The importance of ATP and its function as an energy shuttle and the role of enzymes in speeding up chemical reactions is studied in depth. They are able to explain how competitive and noncompetitive inhibitors alter an enzyme’s activity and explain how certain drugs, pesticides, and poisons can affect enzymes.

The text book Reece et al., Unit 1, Chapter 5 “The working cell” is used as text . The entire chapter is studied. Simple activities/experiments are used to explain the concept of osmosis, by using gummy bears and soaking them in tap water.

Chapter 6- How cells Harvest Chemical energy

The processes and locations of cellular respiration and photosynthesis are compared. Students are able to explain how breathing and cellular respiration are related. They study the overall chemical equation for cellular respiration and explain how the human body uses its daily supply of ATP. They are able to explain how the energy in a glucose molecule is released during cellular

respiration and how redox reactions are used in cellular respiration. They are able to describe the general roles of dehydrogenase, NADH, and the electron transport chain in cellular respiration. The comparison of reactants, products, and energy yield of the three stages of cellular respiration and the role of rotenone, cyanide, carbon monoxide, oligomycin, and uncouplers in interrupting critical events in cellular respiration are studied in detail. The students compare the reactants, products, and energy yield of alcohol and lactic acid fermentation. They are able to distinguish between strict anaerobes and facultative anaerobes. The students can explain how carbohydrates, fats, and proteins are used as fuel for cellular respiration.

The text book Reece et al., is followed, Unit 1, chapter 6, "How cells harvest chemical energy". The students are shown music videos on cellular respiration.

Chapter 7- Photosynthesis

The students define autotrophs, heterotrophs, producers, and photoautotrophs. They can describe the structure of chloroplasts and their location in a leaf. Students can explain how plants produce oxygen and describe the role of redox reactions in photosynthesis and cellular respiration. They can compare the reactants and products of the light reactions and the Calvin cycle. The properties and functions of the different photosynthetic pigments and their role in capturing solar energy is studied in detail. The students are able to explain how the electron transport chain and chemiosmosis generate ATP, NADPH, and oxygen in the light reactions. They are able to compare photophosphorylation and oxidative phosphorylation. Also the students can describe the reactants and products of the Calvin cycle and compare the mechanisms that C_3, C_4, and CAM plants use to obtain and use carbon dioxide. They review the overall process of the light reactions and the Calvin cycle, noting the products, reactants, and locations of every major step. The students are able to understand the greenhouse effect and explain how the ozone layer forms, how human activities have damaged it, and the consequences of the destruction of the ozone layer.

The text book Reece et al., is the text reference. Unit 1, chapter 7 "photosynthesis: using light to make food" is completed. Spinach leaves are looked at under the microscope to see chloroplasts. Students can now compare green leaves versus non-green plant cells and animal cells. Elodea leaves are also seen

Unit 2: Cellular Reproduction and Genetics

This unit helps students get in depth knowledge on cellular reproduction, asexual and sexual reproduction. The process of mitosis and meiosis is understood in great detail. After the knowledge of cellular reproduction students study inheritance patterns, both Mendelian and non-Mendelian. The unit also focuses on gene expression and its regulation. The processes of DNA replication, transcription and translation are studied in depth. Students also gain understanding of reproductive and therapeutic cloning procedures and their relevance to medicine and society.

Chapter 8- Cellular Basis of Reproduction and inheritance

The students are able to compare the parent-offspring relationship in asexual and sexual reproduction and explain why cell division is essential for prokaryotic and eukaryotic life. They gain understanding of how daughter prokaryotic chromosomes are separated from each other during binary fission and are able to compare the structure of prokaryotic and eukaryotic chromosomes. The chapter describes the stages of the cell cycle and lists the phases of mitosis along with the events that are characteristic of each phase. Comparison of cytokinesis in animal and plant cells helps students understand the differences in plant and animal cell division. The relevance of anchorage, cell density, and chemical growth factors in controlling cell division is discussed. The students understand how cancerous cells are different from healthy cells. The functions of mitosis and chromosome pairing are discussed. The students are able to distinguish between somatic cells and gametes and between diploid cells and haploid cells. They are able to explain why sexual reproduction requires meiosis. The students are able to list the phases of meiosis I and meiosis

II and describe the events characteristic of each phase. Comparing mitosis and meiosis and noting similarities and differences is addressed in detail. The role of genetic variation and how it is produced in sexually reproducing organisms is discussed. Karyotyping and chromosomal disorders of both autosomal and sex chromosomes are discussed in detail. The reason why cancer is not usually inherited is discussed.

The book chapter is used as primary means of instruction. Unit 2, chapter 8 “The cellular basis of reproduction and inheritance” is completed. The students do a hands on activity using different colored wool to understand the process of mitosis and meiosis. The students also prepare onion root tip slides to look at the mitotic stages. They also look at prepared slides of mitosis and meiosis under the microscope.

Chapter 9- Patterns of Inheritance

The chapter starts with describing the pangenesis theory and the blending hypothesis. The students are able to define and distinguish between true-breeding organisms, hybrids, the P generation, the F_1 generation, and the F_2 generation. They can define and distinguish between the following pairs of terms: homozygous and heterozygous; dominant allele and recessive allele; genotype and phenotype. Also, they are able to define a monohybrid cross and a Punnett square. Mendel’s law of segregation and the genetic relationships between homologous chromosomes is discussed in detail. Students are taught how Mendel’s law of independent assortment applies to a dihybrid cross. They are able to get an understanding of how and when the rule of multiplication and the rule of addition can be used to determine the probability of an event. Family pedigrees can help determine the inheritance of many human traits is discussed in detail. The inheritance of recessive and dominant disorders along with examples of each is discussed. The students are able to compare the health risks, advantages, and disadvantages of the following forms of fetal testing: amniocentesis, chorionic villus sampling, and ultrasound imaging. They are able to describe the inheritance patterns of incomplete dominance, multiple alleles, dominance, pleiotropy, and polygenic inheritance. They are also able to explain how the sickle-cell allele can be adaptive and why human skin coloration is not sufficiently explained by polygenic inheritance. The students are able to define the chromosome theory of inheritance and explain the chromosomal basis of the laws of segregation and independent assortment. They gain understanding of linked genes and how they are inherited differently from non-linked genes. T. H. Morgan’s studies of crossing over in fruit flies are discussed. Creation of Sturtevant linkage maps is done. The students understand how sex is genetically determined in humans and the significance of the *SRY* gene. They are able to describe patterns of sex-linked inheritance and examples of sex-linked disorders. They are able to explain how the Y chromosome can be used to trace human ancestry.

The text book unit 2, chapter 9 “patterns of inheritance” is completed along with several additional pedigree charts to help students predict genotypes.

Chapter 10- Molecular Biology of the Gene

The chapter begins with the experiments of Griffith, Hershey, and Chase, which supported the idea that DNA was life’s genetic material. The students compare the structures of DNA and RNA and explain how the structure of DNA facilitates its replication. They are able to describe the process of DNA replication and explain how the “languages” of DNA and RNA are used to produce polypeptides. They are able to explain how mRNA is produced using DNA and how eukaryotic RNA is processed before leaving the nucleus. The students can relate the structure of tRNA to its functions in the process of translation. They are able to describe the structure and function of ribosomes and the step-by-step process by which amino acids are added to a growing polypeptide chain. They understand the major types of mutations, causes of mutations, and potential consequences. The students also compare the lytic and lysogenic reproductive cycles of a phage. They compare the structures and reproductive cycles of the mumps virus and a herpes virus and describe three processes that contribute to the emergence of viral disease. The AIDS virus and how it enters a host cell and reproduces is understood. The students also describe the structure of viroids and prions and explain how they cause

disease. They are able to define and compare the processes of transformation, transduction, and conjugation. They are able to define a plasmid and explain why R plasmids pose serious human health problems.

The text book unit 2, chapter 10 “molecular biology of the gene” is discussed completely. The retrovirus HIV and antibiotic resistance is discussed in detail with public health implications in the current scenario. Experiment to extract DNA is done to give the students an idea of DNA as a physical entity.

Chapter 11- How Genes are
regulated

The students are able to describe and compare the regulatory mechanisms of the *lac* operon, *trp* operon, and operons using activators. They can explain how selective gene expression yields a variety of cell types in multicellular eukaryotes and how DNA is packaged into chromosomes. The students understand how a cat’s tortoiseshell coat pattern is formed and why this pattern is only seen in female cats. The regulation of eukaryotic gene expression and the process and significance of alternative DNA splicing is discussed in detail. The students can describe the significance of miRNA molecules and explain how mRNA breakdown, initiation of translation, protein activation, and protein breakdown regulate gene expression. They understand the roles of homeotic genes in development. They learn the technique of DNA microarrays and how they can be used to study gene activity and treat disease. Signal transduction pathways and how they trigger a specific response inside a target cell and comparison of the cell-signaling systems of yeast and animal cells is studied in detail. They are able to explain how nuclear transplantation can be used to clone animals and describe some of the practical applications of reproductive cloning and the process and goals of therapeutic cloning. The students can also explain how viruses, proto-oncogenes, and tumor-suppressor genes can each contribute to cancer. The students understand why the development of most cancers is a slow and gradual process and are able to explain how mutations in *ras* or *p53* proteins can lead to cancer. They can describe factors that can increase or decrease the risks of developing cancer.

The text book unit 2, chapter 11 “how genes are controlled” is completed in entirety. The importance of cloning and its therapeutic significance are discussed with respect to current advances.

Unit 3: Evolution

This unit explains how Darwin’s voyage on the *Beagle* influenced his thinking. The students explain how the work of Thomas Malthus and the process of artificial selection influenced Darwin’s development of the idea of natural selection. They are able to describe Darwin’s observations and inferences in developing the concept of natural selection and explain why individuals cannot evolve and why evolution does not lead to perfectly adapted organisms. The students describe two examples of natural selection known to occur in nature. They can explain how fossils form, noting examples of each process and explain how the fossil record, biogeography, comparative anatomy, and molecular biology support evolution. They understand how evolutionary trees are constructed and used to represent ancestral relationships. The students can define the gene pool, a population, and microevolution. They are able to explain how mutation and sexual reproduction produce genetic variation. They can also explain why prokaryotes can evolve more quickly than eukaryotes. The students describe the five conditions required for the Hardy-Weinberg equilibrium and explain why the Hardy-Weinberg equilibrium is significant to understanding the evolution of natural populations and to public health science. They can define genetic drift and gene flow and explain how the bottleneck effect and the founder effect influence microevolution. The students learn to distinguish the outcome of stabilizing selection, directional selection, and disruptive selection and describe an example of each. They can define and compare intrasexual selection and intersexual selection. Finally they can explain how antibiotic resistance has evolved and why natural selection cannot produce perfection.

The book unit 3, chapters 13, 14, and 15 are completed. A short movie on Darwin is shown to the students before beginning the

chapter.

Chapter 13-The Origin of Species

The students distinguish between microevolution and speciation and compare the definitions, advantages, and disadvantages of the different species concepts. They describe five types of prezygotic barriers and three types of postzygotic barriers that prevent populations of closely related species from interbreeding. They can explain how geologic processes can fragment populations and lead to speciation. Reproductive barriers might evolve in isolated populations of organisms is discussed in relation to evolution. The students can explain how sympatric speciation can occur, noting examples in plants and animals. They can also explain why polyploidy is important to modern agriculture and how modern wheat evolved. They can describe the circumstances that led to the adaptive radiation of the Galápagos finches and explain how reproductive barriers might evolve in isolated populations of organisms. They are able to describe the discoveries made by Peter and Rosemary Grant in their work with Galápagos finches. They can explain how hybrid zones are useful in the study of reproductive isolation.

The text book chapter 13 “How populations evolve” is covered and chapter 14 “the origin of species” is completed.

Chapter 15-Tracing evolutionary History

The students understand the conditions on the surface of the early Earth and are able to describe the evidence that life on Earth existed at least 3.5 billion years ago. They describe the four stages that might have produced the first cells on Earth and describe the experiments of Stanley Miller and others in understanding how life might have first evolved on Earth. They understand the significance of protocells and ribozymes in the origin of the first cells. They can describe the key events in the history of life on Earth and explain how radiometric dating and the relative position of a fossil within rock strata are used to determine the age of rocks. They also describe the history of life on Earth and the key events that serve to divide the eras. The chapter discusses how Earth’s continents have changed over the past 250 million years and the consequences of these changes for life on Earth. They are able to explain how volcanoes and earthquakes result from plate tectonics. The students can describe the causes, frequency, and consequences of mass extinctions over the last 500 million years and explain how and why adaptive radiations occur. They understand how genes that program development function in the evolution of life. They can define and describe examples of paedomorphosis. The concept of exaptation with two examples in birds is discussed. They understand why evolutionary trends do not reflect “directions” or “goals.” The students distinguish between homologous and analogous structures and provide examples of each. They are able to describe the process of convergent evolution. Systematics and progressively broader categories of classification used in systematics in order, from most specific to most general are discussed. The students learn about the terms clade, monophyletic groups, shared derived characters, shared ancestral characters, ingroup, outgroup, phylogenetic trees, and parsimony. They can explain how molecular biology is used as a tool in systematics and how molecular clocks are used to track evolutionary time. They gain understanding of why a diagram of the tree of life is difficult to construct. Understanding of classification, taxa, binomial nomenclature is developed.

The text book unit 3, chapter 15 “tracing evolutionary history” is used as primary source of instruction and is completed.

Unit 4: Animals: Form and Function

This unit describes the levels of organization in an animal’s body. It explains how size and shape can influence the structure of an animal. The students can define a tissue, describe the four main types of animal tissue, and note their structures and their functions. They are able to explain how the structure of organs is based on the cooperative interactions of tissues and explain how artificial tissues are created and used. The goal is to describe the general structures and functions of the 12 major vertebrate organ systems. The knowledge of technology like X-ray, CT, MRI, and PET imaging technologies is gained.

The text book Reece et al., chapters 20, 24, 26, 28 and 30 are used as a primary source of instruction for this unit.

Chapter 24- Immune System

The students describe the functions of neutrophils. They understand the nature of innate defenses in invertebrates and vertebrates and are able to describe the steps of the inflammatory response and explain how they help to prevent the spread of disease. The specific nature of adaptive immune system responses and the development and functions of B lymphocytes and T lymphocytes is understood. They can define and distinguish between the humoral immune response and the cell-mediated immune response and describe the nature of antigens. The antigen and antibody interactions are understood. They can describe the process of clonal selection and compare a primary immune response to a secondary immune response. Also they can describe the specific structure of an antibody and relate its shape to its functions. They can describe the specific functions of helper T cells and how they interact with other cells. The cytotoxic T cells and how they destroy infected body cells is understood. Students can explain how HIV infects cells, multiplies, and causes disease and why it has been difficult to develop a successful treatment for AIDS. They understand autoimmune diseases and organ transplantations and associated challenges. The students can describe how the malfunction or failure of the immune system can cause disease. Also why allergies occur and what causes anaphylactic shock is discussed.

Chapter 26- Endocrine System

The students can compare the mechanisms and functions of the endocrine and nervous systems. They are able to distinguish between the two major classes of vertebrate hormones and describe the different types and functions of vertebrate endocrine organs. The interrelationships between the hypothalamus and pituitary glands and the functions of the thyroid and parathyroid glands are understood. Students understand how insulin and glucagon manage blood glucose levels. They are able to describe the causes and symptoms of type 1 and type 2 diabetes and gestational diabetes. They can compare the functions of the adrenal gland hormones. The students can describe the three major types of sex hormones and their functions.

Chapter 28-Nervous System

The students can describe the structural and functional subdivisions of the nervous system. They understand and describe the three parts of a reflex, distinguishing the three types of neurons that may be involved in the reaction. The structures and functions of neurons and myelin sheaths are understood. They can define a resting potential and explain how it is created along with how an action potential is produced and the resting membrane potential restored. They can explain how an action potential propagates itself along a neuron and compare the structures, functions, and locations of electrical and chemical synapses. Students compare excitatory and inhibitory neurotransmitters and describe the types and functions of neurotransmitters known in humans. They can explain how drugs can alter chemical synapses. They can describe the diversity of animal nervous systems and provide examples. Also students can describe the general structure of the brain, spinal cord, and associated nerves of vertebrates. They also compare the functions of the motor nervous system and autonomic nervous system. The learning also focuses on comparison of the structures, functions, and interrelationships of the parasympathetic, sympathetic, and enteric divisions of the peripheral nervous system. The students describe the main parts and functions of the human brain. They can understand how injuries, illness, and surgery provide insight into the functions of the brain. Also how MRI scans help us understand brain functions is studied. The students gain understanding into the causes, symptoms, and treatments of schizophrenia, depression, Alzheimer’s disease, and Parkinson’s disease.

Chapter 30-Muscular system

The students describe the diverse methods of locomotion found among animals and the forces each method must overcome. They

can describe the three main types of skeletons, their advantages and disadvantages, and provide examples of each. Also students can describe the common features of terrestrial vertebrate skeletons, distinguishing between the axial and appendicular skeletons. They can understand the complex structure of bone, noting the major tissues and their relationship to blood-forming tissues. The students understand why bones break and how we can help them heal. They can describe three types of joints and provide examples of each. They can also explain how muscles and the skeleton interact to produce movement. In depth understanding at the cellular level of how a muscle cell contracts and how a motor neuron signals a muscle fiber to contract is gained. They can describe the role of calcium in a muscle contraction and explain how motor units control muscle contraction. The reason for muscle fatigue and differences between aerobic and anaerobic exercise along with the advantages of each are studied. Finally they can compare the structure and functions of slow, intermediate, and fast muscle fibers.

Key Assignments

1.
Homework

The recurring assignments include a homework assigned from each chapter to review topics by means of questions discussed at the end of each section in a chapter. This helps students to review a topic along with its application**.** The homework also encourages students to build note-taking and writing skills.

2. Poster Presentation

The students are divided into six groups of four each. They are assigned topics from their curriculum to make a poster and give an oral presentation. The poster comprises handwork to draw flow charts or diagrams where appropriate. This is designed to enhance understanding of topics taught in class, team work, research, and writing and presentation skills. The students are given topics based on the chapters on Photosynthesis, cell division, genetics, gene regulation, evolution, and biotechnology techniques. These topics can be changed to some other chapters based on the teacher’s discretion and what is best for the class in their learning process.

3. Research Report

The students write a research report of 10-15 pages on one of the two topics given to them. The topics picked are related to their curriculum but geared towards independent literature search and addressing a key public health or relevant topic spanning over a long timeline. The students are encouraged to use print resources and site a minimum of ten references. They are required to illustrate with charts, photographs and diagrams. Example of an assignment given in 2014-15:

Topics given were: Antibiotic resistance or. GMO, genetically modified
organisms

The students are given a rubric. This covers the expectation of the length and breadth

3. Course content:

Laboratory/Experimentation

1. Time Requirement and General Procedures

1. Most labs will require one (1) class period to complete. Some labs may require more than one period.

A. Pre-lab activities for students include all of the following:

1. Require answer to written questions to understand objectives. 2. Use fill-in flow charts/diagrams to assist in clarification and organization of the lab. 3. Information disseminate on safety, precautions, contaminations, and special equipment. 4. Read and document lab procedures in lab book. 5. Determine individual assignments and responsibilities within each group.

B. Lab Preparation

1. Obtain protective equipment, goggles, masks, aprons, gloves, etc. 2. Safety inspection of lab equipment, cords, Bunsen burners, centrifuge, incubator, glassware. 3. Apply safe handling techniques. 4. Measure and label ingredients.

C. Perform investigation or procedure as documented in the lab book.

1. Specimen preparation for microscope slides. 2. Precautions on cross contaminations. 3. Observe all safety procedures during procedure.

D. Lab write-up

1. Record observations during the procedure, compare and contrast pre- and post- procedures, document color changes and/or precipitation, draw and label specimen and its parts. 2. Use critical thinking and generate investigative questions of lab procedure. 3. Document findings, pH, temperature, time components, measurements by charts and graphs. 4. Compile data for conclusion 5. Answer investigative questions at the end of lab to confirm findings. 6. Incorporate personal comments and thoughts into conclusion.

E. Safety in cleaning and waste disposal

1. Use proper technique to protect from sharp instruments during cleaning. 2. Apply information from Material Safety Data Sheet (MSDS) to determine the proper special disposal containers. 3. Ensure cleaning of equipment,

tables, goggles, etc. with specified solutions or products. 4. Proper disposal of gloves and paper towels. 5. Good hand washing techniques.

List of Labs – Brief Description and Techniques

Lab 1

Scientific Method

Students are given a scenario and asked to use the terms of 'scientific method'. They are given a marsh land scenario where the scientists check the effect of nitrogen on the growth of grass. They are given several plots with different nitrogen concentrations in the fertilizer and length of grass as preliminary data. The students are required to write out the experiment and use the terms control, experimental groups, dependent variable, independent variable and data. They have to plot the data and show the effect of Nitrogen on grass length. This exercise makes them to think logically and use the concepts effectively.

Lab 2

Microscopy and preparation of wet mount of cells

Introduction to microscopy. The students are taught using a light microscope. They prepare wet mounts of eukaryotic cells and observe them under the microscope at low and high magnification. Cheek cells are scraped using a tooth pick from the inner cheek and stained with a drop of methylene blue. The cells are observed and students look for the cellular structures like cell membrane, nucleus and cytoplasm. The students are encouraged to compare the prokaryotic and eukaryotic cells are compared. Methylene blue is used for staining the cheek cells. The lab is intended to make the students familiar with the use of microscopes and the concept of magnification.

Lab 3

Prepare wet mount of plant cells and compare them to animal cells

Make wet mounts of plant (onion peel cells) and plant (elodea)/spinach cells. Look for chloroplasts and compare the onion peel cells without chloroplasts with the elodea leaf cells with many chloroplasts. The elodea leaves show the phenomenon of cytoplasmic streaming. This exercise helps them distinguish between plant cells with and without chloroplasts and also compare the plant cell with its rigid shape to the animal cell with its more irregular shape. Iodine is used for staining the onion peel. The students are questioned on various aspects of the lab exercise.

Lab 4

The phenomenon of osmosis in potato and Plasmolysis in Elodea

This is a lab exercise that enhances the understanding of cell transport. In this lab activity students will observe the effects of osmosis on plant cells. In the first part, they will use the weight of pieces of potato to see how much water moves in and out of cells in different salt solutions. In the second part, you will observe plasmolysis in an aquatic plant, *Elodea*. The students prepare

potato cylinders using acork borer and weigh them. They soak them individually in distilled water, 1% salt, 3% salt, and 5% salt. After 24 hours they weigh the potato cylinders. The students plot graphs and write out conclusions. Plasmolysis is observed in Elodea. Elodea leaves are placed on a slide with tap water and coverslip under the microscope. Using the dropper, place a drop of 5% salt solution on the right edge of the coverslip. Place a small piece of paper towel on the left edge of the coverslip. As the fresh water soaks into the paper towel it will draw the salt water under the coverslip. When observed again, the cell contents have shrunken down, leaving a space between the cytoplasm and the cell wall. The students draw their observations.

Lab 5

Mitosis and Meiosis I and II with the help of colored threads- Dry lab.

Students can get clear understanding of the stages of mitosis and meiosis with the help of this activity. This exercise will help to resolve the confusion students have in understanding the stages of meiosis. The cell division chapters benefit from this lab. The students use 4 different colors to represent 4 different chromosomes and perform all the steps of cell division. It helps them navigate the differences between meiosis I and II which are often a confusing and difficult concept.

Lab 6

Mitosis- Onion root tip cells

Prepare onion root tip slides to look at stages of mitosis. This is done in groups. The students can look at real onion root tip cells with mitosis going on in them. The students follow the manufacturer (Carolina Biologicals) protocol to prepare the slides following all appropriate precautions. They scan the microscope under the 10x objective. They look for the region that has large nuclei relative to the size of the cell; among these cells will be found cells displaying stages of mitosis. The students can switch to the 40X objective to make closer observations. The slides viewed under the microscope showing various mitotic stages. The students also share slides with each other and can see different stages clearly. They draw out what they view under the microscope.

Lab 7

Immune-Response: Antibody/Antigen, Rh factor determination

Students will determine the ABO and Rh antigens and antibodies present in 4 unknown simulated blood samples. Students will understand blood typing and its relationship to transfusion and immune response. Four slides are labeled to correspond to the 4 unknown samples (#1- #4). Corresponding blood samples are dropped into wells of the slides. Anti-A antibody serum is added to first well of each slide and anti-B antibody serum is 2^{nd} well of each slide. Anti-RH is added to the third well. Students will record changes and observations.

Lab 8

DNA Isolation from strawberries

Students isolate DNA from strawberries. This experiment is targeted to make the concept of DNA as a physical reality in terms of its size and what it looks like. Common reagents like salt and detergent are used. It is designed to give a hands on DNA extraction experience and look at each of the steps to understand the chemistry behind it. The chapters on gene regulation and biotechnology are enhanced by this exercise. The students crush strawberries in a plastic bag and add detergent to lyse the cells. The supernatant is filtered out and chilled ethanol is used to precipitate the DNA. The DNA looks like thread and white mucus. The students the able to visualize DNA.

Lab 9

Gel Electrophoresis

Simulation lab of gel electrophoresis. Followed by assignment to check for understanding. This helps the students to understand how DNA fragments resolve on a gel and make it integrate with restriction enzyme digestion so they can calculate where fragments will be based on size. The students are able to do the entire process simulating each step from restriction enzyme digestion to agarose gel preparation and running a gel. They are able to understand the resolution of DNA fragments on gel based on size. They can work at their own pace till they understand the steps. The students complete an extensive worksheet which enables them to clarify concepts.

The website http://learn.genetics.utah.edu/content/labs is used for the gel electrophoresis lab simulation.

Lab 10

Microscopy- Human tissue slides

Human tissue slides from Carolina Biologicals are used. There are representative slides of all body tissues like blood, connective tissue, muscle tissue, nervous tissue, bone and epithelial tissue. This helps the students gain familiarity with the various tissue types and helps them to enhance their knowledge of the body organization units. The students are encouraged to draw the tissue structures and label as many components as they can recognize. The students them discuss their observations.

Assessment Methods and/or Tools

A variety of student assessment methods are used throughout the course. These include classwork/do now, quiz/quizzes, tests, poster/projects, labs, homework assignments and research projects. These are used to accommodate diverse learning styles and for the development of different skills.

In class assessment of understanding is done with the help of short do now exercises. These are used for every chapter. This activity is graded. These are appropriate to test for understanding.

Homework is given to the students at the end of each chapter. The homework questions are targeted to review the key concepts in each chapter. The homework assignments are graded. These give the students the opportunity to practice questions.

Labs are used for some chapters where possible to do. The lab exercises have been mentioned in the assignment section. The labs

can be changed or alternate labs used when possible. If time permits additional activities may be introduced. The purpose of labs is to reinforce concepts done in class with practical exercises. The students do some labs individually and some in groups. Each lab is accompanied by a lab report which is graded. The students are expected to record details of aims, experimental details, observations, results and draw out their observations.

The poster presentations are evaluated and given homework category points based on the work required. This method works well for some students who do not do very well on tests but work hard on posters and present in class. The posters are graded based on the work done on the poster, the presentation of the poster, team cooperation and ability to answer questions during and after the presentation. This is a group grade.

The research project also gives a chance to students to show their research skills and ability to extract important information and in assimilating a vast amount of information in a project effectively. This is also given a homework category grade. The research project is graded based on content, logical presentation of ideas, neatness, and sources used. The topics chosen for this project are

picked from the course content and usually the socially relevant topics which are a subject of common discussion are given. These give the students a chance to reflect upon their opinions and present them effectively.
Students are evaluated after every chapter or sometimes twice with an extensive quiz. The quiz contains various types of question categories to test for understanding. The students are continuously encouraged to draw out pathways, life cycles where needed. The quiz consists of fill in the blank/complete sentences, multiple-choice and essay questions. The quiz is allotted significant points and is a major means of testing student understanding. The questions cover the entire chapter including all concepts and are targeted to understand in depth knowledge and concept clarity.
Students are tested cumulatively at the end of every trimester. This includes the chapters covered in that trimester. The trimester test also consists of a variety of questions similar to a quiz.
The students finally prepare for a final exam which includes their entire curriculum. This exam is designed to test them in retaining vast amount of information and how they can test on it without confusing concepts. The test is inclusive of multiple choice, short answers and some long answers. The students are encouraged to draw flow charts, diagrams where appropriate for full credit.

Course Materials

Textbooks

Title Author Publisher Edition Website Primary Campbell Biology: Concepts and connections Reece, Taylor, Simon, Dickey Pearson Higher Ed 7th Edition [empty] Yes

4. Describe how this course integrates the schools SLO (former ESLRs- Expected School-wide LearningResults):

The course complements the school's SLOs and reinforces them with rigorous curriculum provided by the college board. Pre-AP Biology emphasizes the following instructional priorities:

- **Evaluating evidence:** Students acquire knowledge by evaluating evidence from a wide range of primary and secondary sources. (SLO2: Critical thinkers can use problem-solving skills, including logic and reason and use analytical and interpretive skills to make decisions).

- **Incorporating evidence:** Students demonstrate command of quantitative, qualitative, and spatial data by effectively incorporating them into written and oral arguments. (SLO1: Academic Achievers use effective reading, writing, speaking, and listening skills to produce SLO3: Quality Products showing strategic planning using technology).
- **Explaining historical and geographic relationships:** Students explain relationships among events and people by marshaling evidence for causality, correlation, continuity, and change over time. (SLO 1, SLO 3, and SLO 2)

5. Describe the Integrated ELD teaching techniques to be used to meet the needs of English Language Learners:

All teachers in the Science Department have bilingual, BCLAD or CLAD credentials. They have been trained in AVID strategies and critical reading and writing strategies that match the school's Instructional Vision of implementing the CER model using color-coding to analyze text structure and for students to see the structure mirrored in their own writing. In addition, all teachers use technology resources to enhance student learning.

6. Describe the interdepartmental articulation process for this course:

The Science Department incorporates and reinforces skills which students learn in other departments: critical reading, the Claim, Evidence, Reasoning model of writing, as well as a host of other AVID strategies including Socratic Seminars and Philosophical Chairs designed to help students develop critical thinking, reading, writing and speaking skills. The course allows for open enrollment, but students signing up as Freshmen for other courses in the Pre-AP program (especially English &World History) will be encouraged to enroll.

7. Describe how this course will integrate academic and vocational concepts, possibly through connecting activities. Describe how this course will address work-based learning/school to career concepts:

Participation in Pre-AP courses places students on a path to college readiness. These courses provide students with opportunities to engage deeply with texts, motivating problems to solve and questions to answer, and key concepts that focus on the content and skills central to each discipline. Across the ninth-grade Pre-AP courses, students will experience shared classroom routines that foster and deepen college-readiness skills. Finally, students will take classroom assessments that provide meaningful and actionable feedback on college-readiness indicators.

Each Pre-AP course focuses on three areas of focus that are central to the discipline and that emphasize the role of literacy, quantitative, and analytical skills that enable students to transfer knowledge within and across courses. All five Pre-AP disciplines also share a common set of principles, or routines, that guide classroom practice and undergird the Pre-AP instructional units. These routines further strengthen students' reading, analysis, writing, problem-solving, and communication skills. Through engaging in these routines, students gain regular practice at close observation and analysis, evidence-based writing, higher-order questioning, and academic conversation to ultimately equip them to be better prepared for high school and college-level work. Finally, schools that implement multiple Pre-AP courses provide students with the multiplicative effects of cross disciplinary alignment during the critical early high school years.