CHINO VALLEY UNIFIED SCHOOL DISTRICT
INSTRUCTIONAL GUIDELINES
PRINCIPLES OF THE BIOMEDICAL SCIENCES

Course Number	5931
Department	Project Lead the Way
Prerequisite	None
Length of Course	Two (2) Semesters/One (1) Year
Grade Level	9 - 12
Credit	5 units per semester/10 units of credit – biology science / elective
Repeatable	Not repeatable for credit
UC/CSU	Meets the “d” laboratory science requirement
Board Approved	December 10, 2009

Description of Course – This course will provide additional science and engineering instruction for the college-bound student as well as certain healthcare information. This course provides an introduction to the biomedical sciences through exciting “hands-on” projects and problems. Student work involves the study of human medicine, research processes and an introduction to bio-informatics. The Biomedical Sciences program prepares students for a career in the field of biomedical sciences. This course is aligned to the Project Lead the Way program.

Rationale for Course – Students investigate the human body systems and various health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. A theme through the course is to determine the factors that led to the death of a fictional person. After determining the factors responsible for the death, the students investigate lifestyle choices and medical treatments that might have prolonged the person’s life. Key biological concepts including: homeostasis, metabolism, inheritance of traits, feedback systems, and defense against disease are embedded in the curriculum. Engineering principles including: the design process, feedback loops, fluid dynamics, and the relationship of structure to function are incorporated in the curriculum where appropriate. The course is designed to provide an overview of all the courses in the project lead the way Biomedical Sciences program and to lay the scientific foundation necessary for student success in the subsequent courses.

Standard 1 (Algebra I) – Students understand the symbolic reasoning and calculations with symbols that are central in algebra.

1.1 Objective: Develop an understanding of the symbolic language of mathematics and sciences.

1.1.1 Performance Indicator: Students will add, subtract, multiply, and divide rational expressions and functions. Students will solve both computationally and conceptually challenging problems by using these techniques.

1.1.2 Performance Indicator: Students will apply algebraic techniques to solve rate problems, work problems, and percent mixture problems.

1.1.3 Performance Indicator: Students will determine the domain of independent variables and the range of the dependent variables defined by a graph, a set of ordered pairs, or a symbolic expression.

1.1.4 Performance Indicator: Students will determine whether a relation defined by a graph, a set of pairs, or a symbolic expression is a functional and justify the conclusion.

1.1.5 Performance Indicator: Students will use and know simple aspects of a logical argument by explaining the difference between inductive and deductive reasoning and identify and provide examples of each. Students will identify hypothesis and conclusion in logical deduction.

1.1.6 Performance Indicator: Students will use properties of the number system to judge the validity of results, to justify each step of a procedure, and to prove or disprove statements.

Standard 2 (Science) – Students understand the fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.

2.1 Objective: Understand the concept of life processes of plants and animals depending on the chemical reaction that has occurred in the organism's cell.

2.1.1 Performance Indicator: Students will know cells are enclosed within semi permeable membranes that regulate their interaction with their surroundings.

2.1.2 Performance Indicator: Students will know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.

2.1.3 Performance Indicator: Students will know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.

2.1.4 Performance Indicator: Students will know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosome's in the cytoplasm.

2.1.5 Performance Indicator: Students will know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.

2.1.6 Performance Indicator: Students will know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

2.1.7 Performance Indicator: Students will know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.

2.1.8 Performance Indicator: Students will know most macromolecules (polysaccharides, nucleic acids, proteins, and lipids) in cells and organisms are synthesized from a small collection of simple precursors.

2.2 Objective: Understand that mutation and sexual reproduction lead to genetic variation in a population.

2.2.1 Performance Indicator: Students will know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.

2.2.2 Performance Indicator: Students will know only certain cells in a multi cellular organism undergo meiosis.

2.2.3 Performance Indicator: Students will know how random chromosome segregation explains the probability that a particular allele will be in a gamete.

2.2.4 Performance Indicator: Students will know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).

2.2.5 Performance Indicator: Students will know why approximately half of an individual's DNA sequence comes from each parent.

2.2.6 Performance Indicator: Students will know the role of chromosomes in determining an individual's sex.

2.2.7 Performance Indicator: Students will know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.

2.3 Objective: Understand a multi cellular organism develops from a single zygote, and its phenotypes depend on its genotype, which is established at fertilization.

2.3.1 Performance Indicator: Students will know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).

2.3.2 Performance Indicator: Students will know the genetic basis for Mendel's laws of segregation and independent assortment.

2.3.3 Performance Indicator: Students will know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.

2.3.4 Performance Indicator: Students will know how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes.

2.4 Objective: Understand that genes are set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.

2.4.1 Performance Indicator: Students will know the general pathway by which ribosome's synthesize proteins, using tRNAs to translate genetic information in mRNA.

2.4.2 Performance Indicator: Students will know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.

2.4.3 Performance Indicator: Students will know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.

2.4.4 Performance Indicator: Students will know specialization of cells in multi cellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.

2.4.5 Performance Indicator: Students will know proteins can differ from one another in the number and sequence of amino acids.

2.4.6 Performance Indicator: Students will know why proteins having different amino acid sequences typically have different shapes and chemical properties.

2.5 Objective: Understand the genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

2.5.1 Performance Indicator: Students will know the general structures and functions of DNA, RNA, and protein.

2.5.2 Performance Indicator: Students will know how to apply base-pairing rules to explain precise copying of DNA during semi conservative replication and transcription of information from DNA into mRNA.

2.5.3 Performance Indicator: Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.

2.5.4 Performance Indicator: Students will know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.

2.5.5 Performance Indicator: Students will know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.

2.6 Objective: Understand the frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.

2.6.1 Performance Indicator: Students will know why natural selection acts on the phenotype rather than the genotype of an organism.

2.6.2 Performance Indicator: Students will know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.

2.6.3 Performance Indicator: Students will kno*w* new mutations are constantly being generated in a gene pool.

2.6.4 Performance Indicator: Students will know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.

2.7 Objective: Understand as a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.

2.7.1 Performance Indicator: Students will know how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.

2.7.2 Performance Indicator: Students will know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.

2.7.3 Performance Indicator: Students will know how feedback loops in the nervous and endocrine systems regulate conditions in the body.

2.7.4 Performance Indicator: Students will know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.

2.7.5 Performance Indicator: Students will know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.

2.7.6 Performance Indicator: Students will know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, and lipases), stomach acid, and bile salts.

2.7.7 Performance Indicator: Students will know the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.

2.7.8 Performance Indicator: Students will know the cellular and molecular basis of muscle contraction, including the roles of action, myosin, Ca^{+2}, and ATP.

2.7.9 Performance Indicator: Students will know how hormones (including digestive, reproductive, and osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.

2.8 Objective*:* Understand organisms have a variety of mechanisms to combat disease, as a basis for under-standing the human immune response.

2.8.1 Performance Indicator: Students will know the role of the skin in providing nonspecific defenses against infection.

2.8.2 Performance Indicator: Students will know the role of antibodies in the body's response to infection.

2.8.3 Performance Indicator: Students will know how vaccination protects an individual from infectious diseases.

2.8.4 Performance Indicator: Students will know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.

2.8.5 Performance Indicator: Students will know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.

2.9 Objective: Understand that scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations.

2.9.1 Performance Indicator: Students will select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.

2.9.2 Performance Indicator: Students will identify and communicate sources of unavoidable experimental error.

2.9.3 Performance Indicator: Students will identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.

2.9.4 Performance Indicator: Students will formulate explanations by using logic and evidence.

2.9.5 Performance Indicator: Students will solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.

2.9.6 Performance Indicator: Students will distinguish between hypothesis and theory as scientific terms.

2.9.7 Performance Indicator: Students will recognize the usefulness and limitations of models and theories as scientific representations of reality.

2.9.8 Performance Indicator: Students will analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

2.9.9 Performance Indicator: Students will recognize the issues of statistical variability and the need for controlled tests.

2.9.10 Performance Indicator: Students will recognize the cumulative nature of scientific evidence.

2.9.11 Performance Indicator: Students will analyze situations and solve problems that require combining and applying concepts from more than one area of science.

2.9.12 Performance Indicator: Students will investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings.

Standard 3 (Chemistry) – Students understand the periodic table displays of elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

3.1 Objective: Understand that the periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.

3.1.1 Performance Indicator: Students will know how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electro negativity, and the relative sizes of ions and atoms.

3.1.2 Performance Indicator: Students will know how to use the periodic table to determine the number of electrons available for bonding.

3.1.3 Performance Indicator: Students will know the nucleus of the atom is much smaller than the atom yet contains most of its mass.

3.2 Objective: Understand the biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.

3.2.1 Performance Indicator: Students will know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.

3.2.2 Performance Indicator: Students will know chemical bonds between atoms in molecules such as H_2, CH_4 , NH_3 , H_2 CCH_2 , N_2 , Cl_2 , and many large biological molecules are covalent.

3.2.3 Performance Indicator: Students know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

3.2.4 Performance Indicator: Students will kno*w* how electro negativity and ionization energy relate to bond formation.

3.3 Objective: Understand the conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

3.3.1 Performance Indicator: Students know how to describe chemical reactions by writing balanced equations.

3.4 Objective: Understand the bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.

3.4.1 Performance Indicator: Students will know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.

3.4.2 Performance Indicator: Students will know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.

3.4.3 Performance Indicator: Students will know amino acids are the building blocks of proteins.

3.4.4 Performance Indicator: Students will know the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.

Standard 4 (Communications) – Students read and understand grade-level-appropriate material. Analyze the organizational patterns, arguments, and positions advanced.

4.1 Objective: Read and understand grade-level-appropriate material. Analyze the organizational patterns, arguments, and positions advanced.

4.1.1 Performance Indicator: Students will analyze the structure and format of functional workplace documents, including the graphics and headers, and explain how authors use the features to achieve their purposes.

4.1.2 Performance Indicator: Students will prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.

4.1.3 Performance Indicator: Students will generate relevant questions about readings on issues that can be researched.

4.1.4 Performance Indicator: Students will synthesize the content from several sources or works by a single author dealing with a single issue; paraphrase the ideas and connect them to other sources and related topics to demonstrate comprehension.

4.1.5 Performance Indicator: Students will extend ideas presented in primary or secondary sources through original analysis, evaluation, and elaboration.

4.1.6 Performance Indicator: Students will demonstrate use of sophisticated learning tools by following technical directions (e.g., those found with graphic calculators and specialized software programs and in access guides to world wide web sites on the Internet).

4.1.7 Performance Indicator: Students will critique the logic of functional documents by examining the sequence of information and procedures in anticipation of possible reader misunderstandings.

4.1.8 Performance Indicator: Students will evaluate the credibility of an author's argument or defense of a claim by critiquing the relationship between generalizations and evidence, the comprehensiveness of evidence, and the way in which the author's intent affects the structure and tone of the text (e.g., in professional journals, editorials, political speeches, primary source material).

4.2 Objective: Write coherent and focused texts that convey a well-defined perspective and tightly reasoned argument. The writing will demonstrate students' awareness of the audience and purpose and progression through the stages of the writing process.

4.2.1 Performance Indicator: Students will develop presentations by using clear research questions and creative and critical research strategies (e.g., field studies, oral histories, interviews, experiments, electronic sources).

4.2.2 Performance Indicator: Students will use systematic strategies to organize and record information (e.g., anecdotal scripting, annotated bibliographies). 1.8 Integrate databases, graphics, and spreadsheets into word-processed documents.

4.3 Objective: Know and understand medical terminology to interpret, transcribe, and communicate information and observations necessary for workers in the health care industry.

4.4 Objective: Understand the importance of verbal and nonverbal communication in the health care industry.

Standard 5 (Biotechnology) – Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments.

5.1 Objective: Know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments.

5.1.1 Performance Indicator: Students will understand past, present, and future technological advances as they relate to a chosen pathway.

5.1.2 Performance Indicator: Students will understand the use of technological resources to gain access to, manipulate, and produce information, products, and services.

5.1.3 Performance Indicator: Students will understand the influence of current and emerging technology on selected segments of the economy.

5.1.4 Performance Indicator: Students will understand the impact of enhanced technology, bioethics, epidemiology, and socioeconomics on the health care delivery system.

5.1.5 Performance Indicator: Students will know how to interpret technical materials and medical instrumentation used for health care practices and policies.

5.2 Objective: Understand biotechnology product design and development, laboratory procedures, product licensure, and the regulatory process for product development and clinical trials.

5.2.1 Performance Indicator: Students will understand the process of developing biotechnology products in an industrial setting.

5.2.2 Performance Indicator: Students will understand the role of preclinical and clinical trials in biotechnology product development.

5.2.3 Performance Indicator: Students will know the role of quality assurance in clinical trials.

5.3 Objective: Understand the ethical, moral, legal, and cultural issues related to the use of biotechnology research and product development.

5.3.1 Performance Indicator: Students will understand the relationship between morality and ethics in the development of biotechnology health care products.

5.3.2 Performance Indicator: Students will know the differences between personal, professional, and organizational ethics.

5.3.3 Performance Indicator: Students will understand the necessity for accurate documentation and recordkeeping in biotechnology research and product development.

5.3.4 Performance Indicator: Students will understand the need for ethical policies and procedures in institutions engaged in biotechnology research and product development.