FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

PRINCIPLES OF BIOMEDICAL SCIENCE (PBS)

DATE: January 2016
PROPOSED GRADE LEVELS: 9-12
GRADING: A-F
PREREQUISITE: None
COURSE LENGTH: One Year
SUBJECT AREA: CTE
CREDITS: 5/Semester

CTE Sector / Pathway: Health Science and Medical Technology / Biotechnology
Intent to Pursue 'A-G' College Prep Status: Yes

COURSE DESCRIPTION:

Students explore the concepts of human medicine and are introduced to research processes and to bioinformatics. Hands-on projects enable students to investigate human body systems and various health conditions, including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. Over the length of the course, students work together to determine the factors that led to the death of a fictional person. After pinpointing those factors, the students investigate lifestyle choices and medical treatments that might have prolonged the person's life. The key biological concepts embedded in the curriculum include homeostasis, metabolism, and inheritance of traits, feedback systems, and defense against disease. Where appropriate engineering principles are also incorporated into the curriculum. These include the design process, feedback loops, fluid dynamics, and the relationship of structure to function.

GENERAL GOALS/ESSENTIAL QUESTIONS:

- How do scientists design experiments to find the most accurate answer to the question they are asking?
- How does DNA differ from person to person?
- What is diabetes?
- What is homeostasis?
- What role do basic nutrients play in the function of the human body?
- What is sickle cell anemia?
- What is the connection between genes and proteins?
- What is heart disease?
- How are infectious diseases spread through a population?
- How do the different body systems interact to maintain homeostasis?

CCSS READING COMPONENT:

PBS is comprehensive and provides a general overview of the entire pathway. The course will use PLTW lesson plans and curriculum. There will be a number of research opportunities for students to investigate various jobs in the health profession. Students will utilize a number of different texts in order to gain understanding of concepts. The use of diagrams, graphs, video clips, and scholarly journals will all be used. Students will gain the majority of knowledge through their research and first hand interaction with science phenomena.

CCSS WRITING COMPONENT:

Students will produce a number of research projects throughout the course. Students will be asked to demonstrate their knowledge through writing being certain to support their claims with evidence. There will be a number of different writing prompts they will respond to.

CCSS SPEAKING AND LISTENING COMPONENTS:

Throughout the course, students will often work in pairs to solve a problem or investigate a concept. Communication will be critical for success. Students will use peer feedback and evaluation to help improve success. Students will present their research to the class for feedback and evaluation.

CTE INDUSTRY SECTOR / PATHWAY / STANDARDS

Course is proposed as CTE course code 4245, Biotechnology I, CTE pathway code 196 Health, Science and Medical Technology.

CTE Anchor Standard 2: Communications
Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the (career and college) readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

CTE Anchor Standard 4: Technology
Use technology, including the internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments and information.
4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

CTE Anchor Standard 5: Problem Solving and Critical Thinking
5.3 Use system thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.
5.4 Interpret information and draw conclusions, based on the best decisions.
5.5 Know how to apply mathematical computations related to health care procedures (metric and household, conversions, and measurements).

CTE Anchor Standards 6: Health and Safety
Determine the meaning of symbols, key words, and other domain-specific words and phrases as they are used in a specific scientific of technical context.
6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.

CTE Anchor Standard 7: Responsibility and Flexibility
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own, clearly and persuasively.

7.5 Apply high-quality techniques to product or presentation design and development.
7.8 Explore issues of global significance and document the impact of the Health Science and Medical Technology sector.

CTE Anchor Standard 8: Ethics and Legal Responsibility
Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the work.
8.3 Demonstrate ethical and legal practices consistent with Health Science and Medical Technology sector workplace standards.

Pathway: Biotechnology:

A1.0 Define and assess biotechnology and recognize the diverse applications and impact on society.
A3.0 Demonstrate competencies in the fundamentals of molecular cell biology, including deoxyribonucleic acid (DNA), proteins, and standard techniques for their purification and manipulation.
A3.1 Define and describe the structure and function of DNA ribonucleic acid (RNA) and proteins, explain the consequences of DNA mutations on proteins.
A3.3 Employ standard techniques of DNA extraction, purification, restriction digests, bacterial cell culture, agarose gel electrophoresis, and document and evaluate results.
A4.0 Recognize basic concepts in cell biology and become familiar with the laboratory tools used for their analysis.
A4.5 Discuss the structure and function of the macromolecules that compose cells, including carbohydrates, lipids, DNA, RNA, and protein molecules.
A4.7 Conduct indicator tests for the common macromolecules of the cell.
A5.0 Integrate computer skills into program components.
A5.1 Use the Internet and World Wide Web to collect and share scientific information.

Pathway: **Patient Care Pathway:**
B1.0 Recognize the integrated systems approach to health care delivery services: prevention, diagnosis, pathology, and treatment.
B2.0 Understand the basic structure and function of the human body and relate normal function to common disorders.
B4.1 Conduct basic interviews to acquire new knowledge (e.g., medical and family histories).
B5.0 Know the definition, spelling, pronunciation, and use of appropriate terminology in the health care setting.
B5.1 Use medical terminology in patient care appropriate to communicate information and observations.
B5.2 Accurately spell and define occupationally specific terms related to health care.
B7.0 Apply observation techniques to detect changes in the health status of patients.
B7.1 Demonstrate observation techniques.
B7.2 Differentiate between normal and abnormal patient health status.
B8.0 Demonstrate the principles of body mechanics as they apply to the positioning, transferring, and transporting of patients.
B9.0 Implement wellness strategies for the prevention of injury and disease.
B9.4 Know how to access available wellness services (i.e., screening, exams, and immunizations).

DETAILED UNITS OF INSTRUCTION:

Unit 1

The goal of Unit 1 is to provide the foundation and develop the theme for the course. Students are engaged by reading about a woman, Anna Garcia, who is found dead in her home. Students investigate the scene, gather evidence, and then move to the lab to analyze their findings. Through their examination of key evidence, students learn notebook organization, observation and documentation skills, and the fundamentals of experimental design. Students are introduced to the structure of DNA and investigate how basic molecular biology techniques can be used to connect suspects with a crime scene. Students also discuss the bioethics of scientific research and explore the bounds of Health Insurance Portability Accountability Act (HIPAA) legislation. In each unit of the course, students obtain additional medical history information for Anna, as well as details from her autopsy report as they explore the various illnesses she encountered throughout her life. Students will maintain a medical file for Anna Garcia, compile their ideas and findings over the duration of the course, and ultimately determine her cause of death in the final unit.

Lesson 1.1- Instigating the scene
Lesson 1.2- DNA Analysis
Lesson 1.3- The Findings

Unit 2

The goal of Unit 2 is for students to walk through Anna Garcia's diagnosis of diabetes by completing simulated laboratory tests. Given results of the tests, students can deduce the basic biology of both Type 1 and Type 2 diabetes. Students investigate the connection between insulin and glucose and discuss how feedback systems in the body regulate the function of key hormones. Students investigate the biochemical makeup of food and complete experiments to demonstrate the relationship between energy and food. As students explore diabetes, they are introduced to basic chemistry, the structure and function of macromolecules, and the relationship of these molecules to metabolic function. The causes, symptoms, treatments, and side effects of diabetes are studied, as well as the lifestyle implications associated with this disease. Students examine complications related to diabetes and finally brainstorm and develop an innovation to help with the management or treatment of the disease.

Lesson 2.1- What is Diabetes
Lesson 2.2- The Science of Food
Lesson 2.3- Life with Diabetes

Unit 3

The goal of Unit 3 is for students to learn basic concepts of genetics and inheritance as they explore Anna Garcia's struggle with sickle cell disease. Students examine sickled red blood cells under a microscope and learn what life is like with the disease by reading and writing patient diary entries. They simulate the process of protein synthesis, examine the assembly of the protein hemoglobin, and demonstrate how sickle cell disease results from a mutation that alters a protein product. Students examine the structure of chromosomes and show how traits are passed through generations on the chromosomes in our cells.

Lesson 3.1- The Disease
Lesson 3.2- It's in the Genes
Lesson 3.3- Chromosomes
Lesson 3.4- Inheritance

Unit 4

The goal of Unit 4 is for students to examine the normal function of the human heart and investigate malfunctions in the cardiovascular system that can lead to heart disease. Students complete a dissection to tour heart anatomy and study heart function using probes and data acquisition software. They collect and analyze heart data, including heart rate, blood pressure, and EKG readings, and analyze cardiac test results of Anna Garcia. Students explore the role cholesterol plays in the body. Students further their knowledge of molecular biology as they run gel electrophoresis and complete RFLP analysis to diagnose familial hypercholesterolemia. Students design models to simulate the function of a pump and design visuals to show interventions for blocked coronary vessels.

Lesson 4.1- Heart Structure
Lesson 4.2- The Heart at Work
Lesson 4.3- Heart Dysfunction
Lesson 4.4- Heart Intervention

Unit 5

The goal of Unit 5 is to introduce students to microbiology and infection. Students follow the spread of a simulated epidemic in order to conduct a thorough examination of the agents of disease. Students use clues from their investigation of Anna Garcia's medical history to deduce that she was suffering from a bacterial infection. Through a series of laboratory investigations, students learn the fundamentals of aseptic technique, complete visual identification of bacterial morphology, use the Gram stain to examine bacterial cell structure, and analyze the results of metabolic tests to pinpoint the particular bacterium at the heart of the illness. Students explain the functioning of the human immune system in a visual project and explore how this system is designed to protect against invaders.

Lesson 5.1- Infection

Unit 6

The goal of Unit 6 is for students to put together all they have learned throughout the course to determine Anna Garcia's cause of death. Students will investigate the structure and function of key human body systems and relate the illnesses in the course to a breakdown in these systems. Students will begin to recognize the coordination and interconnections of the body systems required to maintain homeostasis, a precursor to the theme of the Human Body Systems (HBS) course.

Lesson 6.1- Analyzing Anna

TEXTBOOKS AND RESOURCE MATERIALS:

- Laptop
- PLTW Learning Management System (LMS)
- Internet access through FCUSD

SUBJECT CONTENT AREA STANDARDS TO BE ADDRESSED:

HS.LS1.1 - Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

HS-LS1.2 - Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

HS.LS1.6 - From Molecules to Organisms: Structures and Processes

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS.LS2.5 - Ecosystems: Interactions, Energy, and Dynamics
Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS.LS3.1 - Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS.ETS1.1 - Engineering Design
Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS.ETS1.3 - Engineering Design
Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS.ETS1.4 - Engineering Design
Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

DCI - LS1.A - From Molecules to Organisms: Structures and Processes - Structure and Function
Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
DCI - LS1.A - From Molecules to Organisms: Structures and Processes - Structure and Function
All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)
DCI - LS1.A - From Molecules to Organisms: Structures and Processes - Structure and Function
Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
DCI - LS1.A - From Molecules to Organisms: Structures and Processes - Structure and Function
Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
DCI - LS1.C - From Molecules to Organisms: Structures and Processes - Organization for Matter and Energy Flow in Organisms
The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
DCI - LS1.C - From Molecules to Organisms: Structures and Processes - Organization for Matter and Energy Flow in Organisms
As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)
DCI - LS1.C - From Molecules to Organisms: Structures and Processes - Organization for Matter and Energy Flow in Organisms
As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular

respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)
DCI - LS1.C - From Molecules to Organisms: Structures and Processes - Organization for Matter and Energy Flow in Organisms
The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
DCI - LS2.B - Ecosystems: Interactions, Energy, and Dynamics - Cycles of Matter and Energy Transfer in Ecosystems
Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)
DCI - LS3.A - Heredity: Inheritance and Variation of Traits - Inheritance of Traits
Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)
DCI - LS3.B - Heredity: Inheritance and Variation of Traits - Variation of Traits
In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA
DCI - LS3.B - Heredity: Inheritance and Variation of Traits - Variation of Traits
In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)
DCI - LS4.B - Biological Evolution: Unity and Diversity - Natural Selection
Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3)
DCI - LS4.B - Biological Evolution: Unity and Diversity - Natural Selection
The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

DCI - PS1.A - Matter and Its Interactions - Structure and Properties of Matter
Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
DCI - PS1.A - Matter and Its Interactions - Structure and Properties of Matter
The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)
DCI - PS1.A - Matter and Its Interactions - Structure and Properties of Matter
A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)
DCI - PS3.A - Energy - Definitions of Energy
Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's

total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1), (HS-PS3-2)
DCI - PS3.A - Energy - Definitions of Energy
At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2), (HS-PS3-3)

DCI - PS3.B - Energy - Conservation of Energy and Energy Transfer
The availability of energy limits that can occur in any system. (HS-PS3-1)
DCI - PS3.B - Energy - Conservation of Energy and Energy Transfer
Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)

DCI - ETS1.B - Engineering Design - Developing Possible Solutions
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
(HS-ETS1-3)
DCI - ETS1.C - Engineering Design - Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (Secondary to HS-PS1-6)

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
CCRA.R.4 - Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
CCRA.R.6 - Assess how point of view or purpose shapes the content and style of a text.
CCRA.R.7 - Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning, as well as the relevance and sufficiency of the evidence.
CCRA.R.10 - Read and comprehend complex literary and informational texts independently and proficiently.

CCRA.W.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning, relevant, and sufficient evidence.
CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
CCRA.W.3 - Write narratives to develop real or imagined experiences, or events, using effective technique, well-chosen details, and well-structured event sequences.
CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCRA.W.5 - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
CCRA.W.6 - Use technology, including the Internet, to produce and publish writing, and to interact and collaborate with others.
CCRA.W.7 - Conduct short, as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
CCRA.W.9 - Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCRA.W.10 - Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

CCRA.SL.1 - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas, and expressing their own clearly and persuasively.
CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
CCRA.SL.3 - Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style appropriate to task, purpose, and audience.
CCRA.SL.5 - Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

DISTRICT ESLRS TO BE ADDRESSED:
Students will be:

- **Self Directed Learners:** Although this class will utilize partners and small teams for support, the class will be rigorous and challenging. Students will continually face challenges and obstacles they must problem solve. They must track their own learning and evaluate their level of proficiency. This will help create an environment where students are driving their own learning.
- **Effective Communicators:** Students will be assessed in various ways. They will have daily evaluations such as warm ups and exit tickets, as well as summative evaluations such as, exams and final projects.
- **Quality Producer/ Performers:** Students will produce various lab reports and projects throughout the course used for assessment.
- **Constructive Thinkers:** Students will be tasked to problem solve what is taking place with Anna Garcia. At different junctures, students will get new pieces of evidence they must now account for in their explanation of what happened. Students will be forced to rethink old hypotheses and revise their assertions accordingly.
- **Collaborative Workers:** Students will be teamed together as they search for what happened to Anna Garcia. They will research various diseases, concepts, and solve problems together. They will give each other feedback on ideas, and peer-evaluate projects against specific criteria.
- **Responsible Citizens:** Students will leave class with an appreciation for the health profession and a greater understanding of what specific health professionals do. They will be empowered to impact their fellow classmates and family members about the importance of a healthy lifestyle. They will be able to point out risk factors for various diseases and how to lower those risk factors.