

**MT. DIABLO UNIFIED SCHOOL DISTRICT
COURSE OF STUDY**

COURSE TITLE: Principles of Biomedical Science
COURSE NUMBER: 002255
CBEDS NUMBER: 4245
DEPARTMENT: CTE/Science
LENGTH OF COURSE: One year
CREDITS PER SEMESTER: 5
GRADE LEVEL(S): 9-10
REQUIRED OR ELECTIVE: Required/Elective: counts for Biology requirement for high school and as a “D” lab science for UC/CSU

PREREQUISITES:
Required - NA
Recommended - B or better in Algebra I

BOARD OF EDUCATION ADOPTION: (Date of Action Meeting)

COURSE DESCRIPTION: This course is the first in a 3 year series involving the investigation of body systems, health conditions and related careers. Students will solve real world problems while exploring medical treatments, lifestyle choices and research processes. Students investigate the human body systems and various health conditions including: heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. This course is designed to provide the scientific foundation for the subsequent courses (Human Body Systems and Medical Interventions). Most students who enroll in this class are an interest in health careers.

COURSE PURPOSE: In the introductory course of the PLTW Biomedical Science program, students explore concepts of biology and medicine to determine factors that led to the death of a fictional person. While investigating the case, students examine autopsy reports, investigate medical history, and explore medical treatments that might have prolonged the person’s life. The activities and projects introduce students to human physiology, basic biology, medicine, and research processes while allowing them to design their own experiments to solve problems.

COURSE OUTLINE:

Unit 1: The Mystery

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 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.

Unit 2: Diabetes

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.

Unit 3: Sickle Cell Disease

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.

Unit 4: Heart Disease

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.

Unit 5: Infectious Disease

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.

Unit 6: Post Mortem

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.

For Lab Sciences Only

LABORATORY ACTIVITIES:

Laboratory Skills

- Aseptic technique
- Bacterial plating and identification
- Gram staining
- Micropipetting
- DNA gel electrophoresis

Clinical Skills

- Blood pressure measurement and analysis
- EKG analysis
- Pedigree analysis
- Bloodwork analysis

Scientific Experimentation Skills

- Design and conduct reliable scientific experiments
- Analyze and interpret laboratory data
- Construct graphs (by hand and using graphing software)
- Interpolate and extrapolate data from a graph
- Draw conclusions based on experimental data
- Thoroughly and clearly communicate results and conclusions both orally and in writing

KEY ASSIGNMENTS:

Unit 1: Blood Spatter Lab

Design an experiment to investigate how height affects bloodstain patterns, and tie in with the case of Anna Garcia

Case Report

Create a report detailing all of the evidence and draw conclusions as to the method of death

Unit 2: Glucose Tolerance Test

Complete simulated glucose tolerance testing as well as insulin analysis on three patients and draw conclusions about their disease status based on your findings. By analyzing test results, you will deduce what is happening inside the body when a person has Type 1 or Type 2 diabetes

Calorimetry

Calorimetry exercise to see how the body works to harness the power of what we eat through the assembly and disassembly of macromolecules.

Diabetic Innovation

Establish a grant to fund promising research or innovation in the field of diabetes treatment and management. This *grant* will be awarded to the group that proposes and defends the most innovative idea and design. With your team, come up with an idea that you feel will greatly improve the life of a diabetic. Think about all aspects of living with diabetes and brainstorm an innovation that helps diabetics treat, manage, or even cure their disease. Presentations are done as part of the *grant* application

Unit 3: Hematocrit

Examine Anna's blood with a microscope and complete a blood test called a hematocrit in order to determine whether Anna's sickle cell disease was causing her other related health problems

Genetic Code

Investigate protein synthesis, transcription, translation, and the various effects that mutations have on DNA and protein production

Unit 4: Heart Dissection

Dissect a sheep's heart, a four-chambered structure analogous to the human heart. Observe key structures and discuss how structure relates to function

Heart Rate + Blood Pressure Labs

Design experiments around heart rate and blood pressure, what affects both of these, as well as what changing heart rate or blood pressure has on human body systems

Gel Electrophoresis

Use DNA electrophoresis to separate and analyze DNA fragments. Use your final gel to determine if Anna and members of her family have familial hypercholesterolemia

Heart Interventions

Design a heart disease intervention plan for an assigned patient, and create/present a model of this intervention.

Unit 5: Gram Staining

Create bacterial smears on microscope slides and perform a Gram stain on three types of bacteria, including the bacteria isolated from Anna's sample

Unit 6: Final Autopsy Report

Create a final autopsy report and put together all you know to determine Anna's cause of death, and list interventions or innovations that could have saved her life

INSTRUCTIONS METHODS and/or STRATEGIES:

- Project Based Learning
- Guided Inquiry projects
- Modeling
- Direct instruction (minimal)

ASSESSMENTS INCLUDING METHODS and/or TOOLS

- Project-based learning (Graded by rubric)
 - Cumulative unit presentations
 - Medical Innovations for real life medical phenomenon
- Unit exams
- End of Course Exam

INSTRUCTIONAL MATERIALS:

- Course laptops to allow for research and exploration of biomedical concepts
- Inspiration concept mapping tool
- Google Classroom
- PLTW Curriculum
- Equipment and Software Proficiencies
 - Microsoft Office (Excel, Word, PowerPoint)
 - Vernier probes and sensors
 - Data acquisition Software (Vernier Logger *Pro*)
 - Microscope

For CTE Pathway:

This course is designed with an industry partner and to be scheduled in a course sequence as follows.

Industry Partner: PLTW

Sequence of Courses: Principles of Biomedical Science (Year One)

Human Body Systems (Year Two)

Medical Interventions (Year Three)

Committee Members:

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| 1. Dylan Bland, PLTW Instructor | 4. Heather Fontanilla, Administrator, Career Pathways & Linked Learning |
| 2. Marcus Thomas, PLTW Instructor | 5. David Saucedo |
| 3. Al Douex, PLTW Instructor | 6. |