Principles of the Biomedical Sciences Field Test Detailed Outline

Unit One: The Mystery (31 days)

Lesson 1.1: Investigating the Scene (15 days)

Understandings Addressed in Lesson:

1. Principles of biomedical science can be used to investigate the circumstances surrounding a mysterious death.
2. Experiments are designed to find answers to testable questions.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that processing a crime scene involves purposeful documentation of the conditions at the scene and the collection of any physical evidence.
- Describe how evidence at a crime scene, such as blood, hair, fingerprints, and shoeprints can help forensic investigators determine what might have occurred and help identify or exonerate potential suspects.
- Recognize that bloodstain patterns left at a crime scene can help investigators establish the events that took place during the crime.
- Recognize that all external variables in an experiment need to be controlled.
- Analyze key information gathered at a simulated crime scene.
- Design a controlled experiment.
- Graph and analyze experimental data to determine the height associated with bloodstain patterns.

Lesson 1.2: DNA Analysis (9 days)

Understandings Addressed in Lesson:

1. Human DNA is a unique code of over three billion base pairs that provides a genetic blueprint of an individual.
2. DNA is packaged as chromosomes, which each contain numerous genes or segments of DNA sequence that code for traits.
3. DNA from all living organisms has the same basic structure – the differences are in the sequences of the nucleotides.
4. Restriction enzymes recognize and cut specific sequences in DNA.
5. Gel electrophoresis separates DNA fragments based on size and is used in Restriction Fragment Length Polymorphism (RFLP) analysis.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the relationship between DNA, genes, and chromosomes.
- Describe the structure of DNA.
- Describe the structure of a nucleotide.
- Explain how restriction enzymes cut DNA.
- Describe how gel electrophoresis separates DNA fragments.
- Recognize that gel electrophoresis can be used to examine DNA differences between individuals.
- Demonstrate how restriction enzymes work.
- Demonstrate the steps of gel electrophoresis and analyze the resulting restriction fragment length polymorphisms (RFLPs).

Lesson 1.3: The Findings (7 days)

Understandings Addressed in Lesson:

1. The purpose of an autopsy is to answer any questions about the illness, cause of death, and/or any co-existing conditions.
2. Determining the manner of death involves the investigation of many aspects, including the medical condition of the victim, the internal and external examination of the body, the chemical and microscopic analysis of tissues and body fluids, and the analysis of all evidence found at the scene.
3. A comprehensive set of standards and practices is necessary in order to give patients specific rights regarding their personal health information.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe how an autopsy is performed and the types of information it provides to officials regarding the manner and cause of death.
- Recognize that a variety of biomedical science professionals are involved in crime scene analysis and determination of manner of death in mysterious death cases.
- Interpret information from an autopsy report to predict the manner of death.
- Explain the importance of confidentiality when dealing with patients, and describe the major patient protections written into the Health Insurance Portability and Accountability Act (HIPAA).
- Analyze patient confidentiality scenarios.

Unit Two: Diabetes (38 days)

Lesson 2.1: What Is Diabetes? (10 days)

Understandings Addressed in Lesson:

1. Diabetes is a disorder characterized by high blood glucose levels and caused by insufficient insulin or the inability of the insulin to function properly.
2. Diabetes can be diagnosed and further characterized as Type 1 or Type 2 by measuring glucose and insulin levels in the blood or urine.
3. The human body uses feedback mechanisms to maintain homeostasis.

4. It is important to evaluate a source of information to ensure the information is accurate and unbiased.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that insulin is the protein that regulates the transfer of glucose into body cells.
- Recognize that blood glucose levels are regulated by the feedback action of the hormones insulin and glucagon.
- Graph laboratory blood glucose and insulin level data and interpret results.
- Compare Type 1 and Type 2 diabetes.
- Demonstrate the role of insulin in transferring glucose from blood into cells.
- Diagram the feedback relationship of blood glucose and the hormones insulin and glucagon.
- Evaluate web resources to determine their level of credibility.

Lesson 2.2: The Science of Food (13 days)

Understandings Addressed in Lesson:

1. Foods contain macromolecules, particularly carbohydrates, lipids, and proteins, which are broken down and reassembled for use in the human body.
2. The human body utilizes nutrients, vitamins, and minerals consumed in food to maintain overall health and homeostasis.
3. Energy is stored in the chemical bonds of the macromolecules found in food.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe which foods are high in carbohydrates, lipids, and proteins.
- Recognize that the nutritional content of food helps individuals make decisions about diet and maintain good health.
- Describe basic nutritional terms as well as identify the role of each nutrient in the body.
- Recognize that the structure of macromolecules is related to their function in the human body.
- Explain the process of calorimetry and how it is used to measure the amount of energy in a food.
- Analyze food labels and food choices for nutritional content.
- Demonstrate the processes of dehydration synthesis and hydrolysis.
- Perform calorimetric measurements on food items and interpret the results.

Lesson 2.3: Life With Diabetes (15 days)

Understandings Addressed in Lesson:

1. Diabetes affects the overall health of the individual as well as aspects of daily life.

2. Blood glucose concentration affects osmosis, the movement of water in and out of body cells.
3. Type 1 and Type 2 diabetes can cause significant complications in many human body systems.
4. Scientists need to make sure that what they present is accurate and is communicated in a way that keeps interest and focus.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that a wide variety of treatment and management medical interventions are available to diabetics.
- Recognize that regulation of blood sugar is necessary to avoid severe and life-threatening diabetic emergencies.
- Be able to advise a patient newly diagnosed with diabetes on treating and living with the disease.
- Compare Type 1 and Type 2 diabetes.
- Demonstrate how water moves across a cell membrane to balance the level of dissolved solutes on either side.
- Diagram complications of diabetes on a human body graphic organizer.
- Assess the qualities of a successful oral and visual presentation.

Unit Three: Sickle Cell Disease (25 days)

Lesson 3.1: The Disease (6 days)

Understandings Addressed in Lesson:

1. Sickle cell disease is caused by an abnormal type of hemoglobin which causes red blood cells to become shaped like crescents or sickles.
2. Sickle cell disease and anemia cause many health problems and affect daily life for someone with the disease.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Explain the function of each of the major components of blood.
- Recognize that anemia is a deficiency in red blood cells or hemoglobin.
- Recognize that a hematocrit, a test performed to determine if someone is anemic, is the percent of the volume of whole blood that is composed of red blood cells.
- Compare normal vs. sickle-shaped red blood cells.
- Demonstrate how sickle-shaped red blood cells lead to decreased oxygen flow to body tissues.
- Create diary entries for a sickle cell patient and reflect on what living with sickle cell anemia is like.

Lesson 3.2: It's In the Genes (9 days)

Understandings Addressed in Lesson:

1. Proteins are produced through the processes of transcription and translation.
2. Changes in the genetic material may cause changes in the structure and function of a protein and consequently the traits of an organism.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that the sequence of nucleotides in DNA determines the sequence of amino acids in a protein.
- Explain the process of protein synthesis.
- Explain how changes in the b-globin protein are due to the mutation associated with sickle cell disease.
- Demonstrate transcription and translation to create a simulated protein.
- Analyze the effect that base pair mutations have on a simulated protein.
- Manipulate computer simulated proteins to visualize the interactions between amino acids and analyze protein structural changes.

Lesson 3.3: Chromosomes (4 days)

Understandings Addressed in Lesson:

1. Chromosomes transfer genetic material from cell to cell as well as from generation to generation, in processes called mitosis and meiosis.
2. There are often several forms of each gene, some being dominant over the others.
3. There are many moral, ethical, and legal considerations surrounding the right to a person's tissues and organs.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that in order for cellular division to occur, exact copies of the DNA must be transferred to the resulting daughter cells.
- Recognize that chromosomes in reproductive cells contain numerous genes that carry traits through the generations.
- Demonstrate the processes of mitosis and meiosis.
- Model the inheritance of genetic diseases.
- Analyze genotype to determine phenotype.
- Use proper techniques to examine, count, and measure chromosomes.
- Appraise the rights a person has to the use of his or her tissues and/or organs.

Lesson 3.4: Inheritance (6 days)

Understandings Addressed in Lesson:

1. The expression of a trait through the generations of a family can be visualized using a pedigree.

2. A Punnett square is a simple graphical way of discovering all of the potential combinations of genotypes of an offspring and can be used to determine the percent chance of each genotype occurring.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Explain how pedigrees can be used to determine the mode of inheritance of genetic diseases.
- Draw and analyze pedigree charts to illustrate passage of a trait through generations.
- Determine and compare the experimental probability and the theoretical probability of inheriting a trait.
- Analyze pedigrees to calculate the probability of inheriting a trait or disease.

Unit 4: Heart Disease (39 days)

Lesson 4.1: Heart Structure (7 days)

Understandings Addressed in Lesson:

1. The human heart is a four-chambered muscular pump designed to provide the force needed to transport blood through all the tissues of the body.
2. The heart's pulmonary circuit pumps blood to the lungs to pick up oxygen, while the systemic circuit pumps oxygenated blood out to the tissues of the body.
3. The structure of blood vessels relates to their overall function.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Identify the main structures of the heart and describe their functions.
- Outline the path of the major blood vessels to and from the heart.
- Recognize that heart valves function to keep blood moving in the proper direction.
- Recognize that arteries move blood away from the heart and veins carry blood back to the heart.
- Compare the structure and function of arteries and veins.

Lesson 4.2: The Heart at Work (11 days)

Understandings Addressed in Lesson:

1. Heart rate, EKG, and blood pressure measurements are indicators of a person's overall cardiac health.
2. Experiments are designed to find answers to testable questions.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that the heartbeat is caused by the contraction of muscle cells and results in the movement of blood from the heart to the arteries and the rest of the body.
- Recognize that heart rate is the number of heart contractions per unit of time, usually per minute.
- Recognize that blood pressure is a measure of the force put on the vascular walls by the blood as it is pushed by the cardiac muscles through the blood vessels.
- Recognize that the electrical activity of the heart can be measured and recorded by an electrocardiogram (EKG or ECG).
- Describe how internal and external factors can affect heart function and can contribute to the development of heart disease.
- Recognize that all external variables in an experiment need to be controlled.
- Measure heart rate and blood pressure manually and with scientific software and probes.
- Design controlled experiments to test the effect of factors such as exercise or body position on heart rate and blood pressure.
- Analyze EKG readings and relate resultant data to heart function.

Lesson 4.3: Heart Dysfunction (12 days)

Understandings Addressed in Lesson:

1. Cholesterol is a lipid that is necessary for the proper functioning of cells and for maintaining a healthy body.
2. The measurement of the HDL and LDL complexes may indicate a person's risk for heart disease.
3. Restriction Fragment Length Polymorphism (RFLP) analysis can be used to diagnose genetic disease and disorders.
4. The human heart pumps blood around the body, and the efficiency of this pump is affected by the rate at which blood can move through the vessels.
5. Experiments are designed to find answers to testable questions.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that cholesterol is transported in the blood by protein complexes called high density lipoprotein (HDL) and low density lipoprotein (LDL).
- Describe how restriction enzymes and gel electrophoresis can be used to analyze genetic information.
- Describe how cholesterol buildup can impact blood flow through arteries.
- Compare and contrast the role of HDL and LDL in the body and how each relates to health.
- Use proper laboratory techniques to separate DNA fragments by gel electrophoresis.
- Analyze the results of the gel electrophoresis to correctly diagnose the presence of the familial hypercholesterolemia mutation.
- Generate ideas as a team to solve a problem.

- Design a controlled experiment to demonstrate how cholesterol plaques impact flow rate in blood vessels.

Lesson 4.4: Heart Intervention (9 days)

Understandings Addressed in Lesson:

1. A blocked coronary artery can lead to tissue death causing a myocardial infarction, or heart attack.
2. Risk factors such as genetics, poor diet, high cholesterol, high blood pressure, diabetes, and smoking increase a person's risk of developing heart disease.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the function of an angiogram in diagnosing blocked vessels.
- Recognize that blocked blood vessels can be treated surgically using procedures that tunnel through or around the areas that disrupt normal blood flow.
- Explain how lifestyle changes as well as medication or medical treatment may help decrease heart disease risk.
- Demonstrate a technique used to open a blocked vessel.
- Analyze medical data and brainstorm causes of death linked to the cardiovascular system.
- Analyze heart disease risk and design a risk reduction program.

Unit 5: Infectious Disease (20 days)

Lesson 5.1: Infection (20 days)

Understandings Addressed in Lesson:

1. Infectious diseases are caused by infectious agents and are transmitted in a variety of manners.
2. Aseptic technique assures that contaminants are not introduced into a specimen and that infectious agents are not spread to people or laboratory surfaces.
3. Bacteria are characterized by their shape, colony morphology, metabolism, and reaction to the Gram stain.
4. The specific structures of the immune system function to protect the human body against foreign invaders.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the mode of transmission and mode of reproduction of various infectious agents.
- Describe the prevention of and treatment for various infectious agents.
- Identify the basic structures of a bacterial cell.
- Describe how the immune system responds when an antigen enters the body.
- Demonstrate the transmission of a simulated infectious agent.

- Compare and contrast the biology and pathology of various infectious agents.
- Use proper aseptic technique to isolate bacterial colonies.
- Perform a gross examination of bacterial colonies to differentiate an unknown bacterial sample.
- Use proper Gram staining and microscope techniques to stain, observe, and classify bacteria.
- Chemically examine and identify unknown bacteria.

Unit 6: Post Mortem (8 days)

Lesson 6.1: Analyzing Anna (8 days)

Understandings Addressed in Lesson:

1. The human body is composed of multiple body systems working together to maintain good health.
2. Scientists need to make sure that what they present is accurate and is communicated in a way that keeps interest and focus.
3. Determining the cause of death involves the investigation of many aspects of the medical condition of a victim, the internal and external examination of the body, and the chemical and microscopic analysis of tissues and body fluids.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Explain the functions of different human body systems and list the major organs within each system.
- Describe how multiple body systems are interconnected and how those interconnections and interactions are necessary for life.
- Demonstrate the ways an illness affects the various body systems.
- Deliver a quality visual and oral presentation.
- Analyze autopsy reports and medical history documents to determine cause of death.

Human Body Systems Detailed Outline

Unit One - Identity
Time Days (26 Days)

Lesson 1: Identity: Human (4 Days)
Understandings Addressed in Lesson

1. The human body is made up of complex systems functioning together to maintain homeostasis.
2. Directional terms describe the position of anatomical structures in relation to other structures or locations in the body, and regional terms specify distinct anatomical landmarks on the body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify the systems and structures involved in basic body processes.
- Explain the functions of different human body systems, and list the major organs within each system.
- Describe how multiple body systems are interconnected and how those interconnections and interactions are necessary for life.
- Explain how directional terms and regional terms can be used to pinpoint location on the body.
- Show the relationship between multiple human body systems.
- Demonstrate the correct use of directional and regional terms.
- Illustrate key directional term pairs on a model of the human body.

Lesson 2: Identity: Tissues (12 Days)
Understandings Addressed in Lesson:

1. A tissue is a group of similar cells designed to carry out a specific function.
2. The bones of the human skeletal system protect the body's internal organs while allowing for movement and great range of mobility.
3. The specific structure of bone reveals information about a person's gender, stature, age, and ethnicity.
4. The length of long bones in the human body can be used to mathematically predict the overall height of an individual.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify characteristics of the four categories of human tissue.
- Describe the functions of the human skeletal system.
- Recognize that differences in bone structure contribute to a person's unique identity.
- Recognize that there is a relationship between the length of long bones and the overall height of an individual.
- Analyze the structure of various human tissue types to infer function.
- Identify and locate bones of the human skeletal system.
- Interpret bone markings, bone landmarks, and bone measurements to determine a person's gender, age, stature, and ethnicity.
- Derive and analyze a linear equation.

Lesson 3: Identity: Molecules and Cells (10 Days)

Understandings Addressed in Lesson:

1. Human DNA is a unique code of over three billion base pairs that provides a genetic blueprint of an individual.
2. Restriction enzymes recognize and cut specific sequences in DNA.
3. Gel electrophoresis separates DNA fragments based on size and is used in Restriction Fragment Length Polymorphism (RFLP) analysis.
4. Physical characteristics can be used to confirm or authenticate identity.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Explain how restriction enzymes cut DNA.
- Describe how gel electrophoresis separates DNA fragments.
- Recognize that gel electrophoresis can be used to examine DNA differences between individuals.
- Outline current biometrics technology.
- Digest DNA samples using restriction enzymes.
- Demonstrate the steps of gel electrophoresis and analyze the resulting restriction fragment length polymorphisms (RFLPs).

Unit Two – Communication

Time Days (38 Days)

Lesson 1: The Brain (9 Days)

Understandings Addressed in Lesson:

1. Communication between body systems is crucial to maintaining homeostasis.
2. The brain receives stimuli from the outside world, interprets this information, and generates an appropriate response.
3. Each region within the brain helps control and regulate specific functions in the body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the structure and function of the central nervous system.
- Identify major regions of the human brain.
- Match regions of the brain with their primary function in the human body.
- Apply knowledge of brain structure and function to determine the parts of the brain related to specific human actions, emotions, and/or dysfunctions.
- Interpret how a breakdown in communication in the central nervous system would impact the function of the human body.

Lesson 2: Electrical Communication (15 Days)

Understandings Addressed in Lesson:

1. Neurons convey information using electrical and chemical signals.
2. The body's reaction time to reflex and voluntary actions is related to the degree of processing in the nervous system.
3. Errors in electrical communication can impact homeostasis in the human body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that the nervous system relies on specialized cells called neurons to pass signals to and from the brain and spinal cord.
- Describe how the movement of ions across the cell membrane of a neuron generates an action potential and propogates electrical signals.
- Explain how neurons communicate at the synapse.
- Describe how brain processing differs in reflex and voluntary responses.
- Outline what goes on in the human body from an initial stimulus to a response.
- Analyze experimental data to explore reaction time and reflexes in the human body.
- Design an experiment to test factors that impact reaction time.
- Analyze case studies to determine the effects of a communication breakdown in the nervous system on the human body.

Lesson 3: Chemical Communication (6 Days)

Understandings Addressed in Lesson:

1. The endocrine system helps the body communicate through the use of chemical signals called hormones.
2. Hormones help maintain homeostasis through feedback loops.
3. A hormone imbalance can lead to disease or dysfunction.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the way in which hormones interact with target cells.
- Recognize that the human body uses feedback mechanisms to maintain proper hormone levels.
- Model a feedback loop that shows how the body maintains homeostasis.
- Analyze physical symptoms of a patient and relate these symptoms to errors in chemical communication.

Lesson 4: Communication with the Outside World (8 Days)

Understandings Addressed in Lesson:

1. The structures within the human eye work to focus and process light.
2. The eye allows perception of color, depth, brightness, and optical illusions.
3. Errors in the structure and function of the eye can lead to problems in acuity or dysfunction.
4. Problems with focusing light in the eye can be corrected with lenses.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify the key structures of the eye.
- Demonstrate how light is processed in the eye in a person with normal vision, as well as a person with myopia or hyperopia.
- Explain the tests and procedures in a typical eye exam.
- Diagram the path of light as it enters the eyes and travels to the brain for processing.
- Evaluate visual perception by testing depth perception, peripheral vision, color vision, and visual acuity.
- Experiment with lenses to refocus light and correct problems with vision.

Unit Three - Power

Time Days (33 Days)

Lesson 1: Introduction to Power (2 Days)

Understandings Addressed in Lesson:

1. Many human body systems work to create, process, and distribute the body's main resources – food, water, and oxygen.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- List and describe the human body systems that create, process, and distribute food, water, and oxygen.
- Recognize that factors unique to the person, such as age, weight, and overall health affect the body's ability to utilize biological resources and maintain homeostasis.
- Recognize that factors in the environment, such as climate or temperature, affect the body's ability to utilize biological resources and maintain homeostasis.
- Estimate how long the human body can last without food, without water, and without oxygen.

Lesson 2: Food (12 Days)

Understandings Addressed in Lesson:

1. Enzymes are usually proteins and act as catalysts which speed up chemical reactions in the human body. (Optional)
2. The digestive system consists of the gastrointestinal tract and the accessory digestive organs which function together to chemically and mechanically digest food, absorb water and nutrients, and remove wastes.
3. Metabolism, the sum of all the chemical reactions that occur within the body, is required to maintain homeostasis.
4. When a process in the body requires energy, ATP is broken down to liberate energy stored in its chemical bonds.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that enzymes are designed to be highly specific, and the structure of the enzyme's active site determines the substrate it acts upon. (Optional)
- Recognize that factors such as temperature, pH, and enzyme and substrate concentration affect the rate of an enzyme-catalyzed reaction.
- List specific enzymes that digest carbohydrates, fats, and proteins at sites along the digestive tract.
- Describe the structure and function of the organs in the digestive system.
- Explain how energy is stored in ATP.
- Model the interaction between enzymes and their corresponding substrates. (Optional)
- Outline what happens to a bite of food as it travels down the digestive tract.
- Design a laboratory experiment investigating the impact that environmental changes can have on enzyme function and analyze the results.

- Analyze energy inputs and outputs in the body to assess overall health.

Lesson 3: Oxygen (8 Days)

Understandings Addressed in Lesson:

1. The structure of the lungs and the close association between the lungs and the vesels of the cardiovascular system facilitate the transport of oxygen to all cells in the body.
2. During normal breathing, a healthy individual is using only a small percentage of the total capacity of his or her lungs.
3. The amount of oxygen required by the cells in a body depends on the activity level of the cells.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the structure of the respiratory system, especially the lungs, and the basic mechanics of breathing.
- Explain how the structure of the lungs facilitates the exchange of oxygen and carbon dioxide between air and the body.
- Recognize that during and after exercise the concentration of oxygen removed from the air is increased compared to when the individual is at rest.
- Use sensors to measure lung capacity and oxygen capture.
- Analyze data collected using a spirometer to determine tidal volume, vital capacity, and minute volume.
- Analyze data collected using an oxygen sensor to determine the change in oxygen concentration of inhaled air versus exhaled air.

Lesson 4: Water (11 Days)

Understandings Addressed in Lesson:

1. The urinary system helps maintain homeostasis in the body by filtering the blood, regulating water and electrolyte concentration, maintaining the pH balance of the blood, and ridding the body of liquid waste called urine.
2. Through filtration, reabsorption, and secretion, the nephron assists in maintaining normal values of water, electrolytes, pH, and blood pressure in the body.
3. The hormones aldosterone and antidiuretic hormone (ADH) both help regulate the amount of water in the body.
4. Malfunctions in the body can be identified through noticeable changes in the composition of urine, and these changes can be detected through urinalysis.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the structure and function of the human urinary system.
- Describe how the structure of the kidney relates to its function in the body.
- Recognize that the nephron is the structural and functional unit of the kidney.
- Describe the connections between urine and blood and the exchange of ions and fluids that occurs across the nephron.
- Illustrate the path of urine formation through the kidney.
- Estimate the filtration rate of the glomerulus and relate mathematical estimates to the function of the human kidney.
- Analyze urinalysis results to diagnose disease and dysfunction in human body systems.

Unit Four - Movement

Time Days (42 Days)

Lesson 1: Joints and Motion (5 Days)

Understandings Addressed in Lesson:

1. The skeletal system works with the muscular system to move the human body.
2. The types of joints found in the human body differ in both structure and function and are classified as such. U
3. Range of motion describes a joint's possible movements as well as provides a measure of overall flexibility at a joint.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that a joint is the location at which two or more bones connect, allowing movement and providing support to the human skeleton.
- Describe the motion at joints, such as flexion and extension.
- Demonstrate the types of movement possible at a joint and match range of motion photographs to specific actions.
- Measure range of motion of human joints using a goniometer.

Lesson 2: Muscles (15 Days)

Understandings Addressed in Lesson:

1. Through contraction and relaxation, the three different types of muscle tissue - skeletal, cardiac, and smooth - produce body movements, stabilize body position, move substances within the body, and regulate heat.
2. The structure of the muscle and attachment of this muscle to bone directly relates to the function of each skeletal muscle.
3. Muscles are composed of units called sarcomeres, which contract and shorten when exposed to electrical stimuli.
4. Calcium ions and ATP play a role in the contraction of muscle fibers.

5. Neurons are packed together in wiring called nerves, and these nerves take electrical messages from the brain to muscle.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe how the three types of muscle tissue differ in structure and function.
- Explain the sliding filament mechanism of muscle contraction.
- Recognize the connection between nerves and muscle.
- Analyze muscle tissue structure using a microscope.
- Interpret muscle function by examining its structure and its attachment to bones.
- Test the effect of varying solutions of ATP on the contraction of muscle tissue.
- Demonstrate the process of muscle contraction as well as the phenomenon of rigor mortis.

Lesson 3: Blood Flow (11 Days)

Understandings Addressed in Lesson:

1. The heart pumps blood to the lungs to pick up oxygen and to the body to deliver this oxygen.
2. The structure of arteries, veins, and capillaries relates directly to the function of each vessel and to the amount of pressure exerted on the vessel walls.
3. Changes in cardiac output, the amount of blood that is pumped out by the ventricles per minute, often signal diseases of the heart, and these changes can impact the function of other body systems.
4. Increased blood pressure in vessels can indicate possible blockages, and these blockages can interrupt blood flow to an organ or limb.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Explain the relationship between the heart and the lungs.
- Identify the body's major arteries and veins and
- name the body region supplied by each.
- Recognize that unlike arteries, veins contain valves that prevent the backflow of blood.
- Describe pulse and blood pressure as they relate to cardiovascular health.
- Recognize that lifestyle choices, such as poor diet and smoking, can lead to the development of blood flow disorders.
- Trace blood flow in pulmonary and systemic circulation.
- Calculate and interpret cardiac output values and relate the amount of blood pumped by the heart to the health of other body systems and organs.
- Measure peripheral pulses using Doppler ultrasound and calculate an ankle brachial index (ABI).

- Interpret the ankle brachial index (ABI) to determine possible blockages in blood vessels.

Lesson 4: Energy and Motion: Exercise Physiology (10 Days)

Understandings Addressed in Lesson:

1. Exercise requires the coordinated effort of many human body systems, including the nervous system, the muscular system, the skeletal system, the cardiovascular system, and the respiratory system.
2. An athlete training for an intense physical event needs to consider diet, exercise, hydration, and injury prevention as well as track his or her progress and modify the plan to meet the demands of exercise.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that the body uses high energy molecules such as creatine phosphate, glycogen, and glucose to supply ATP to working muscle.
- Recognize that muscle fatigue occurs with prolonged or repetitive use of a muscle group.
- Describe ways in which an athlete can prepare his or her body for the stress of an athletic event.
- Illustrate the body's response to the stages of exercise.
- Design an experiment to test the effect of feedback, coaching, or competition on muscle fatidgue.
- Interpret EMG and grip strength data to assess muscle fatigue.
- Apply knowledge of power and movement in the body to design a comprehensive training plan for an athlete.

Unit Five – Protection

Time Days (22 Days)

Lesson 1: The Skin (6 Days)

Understandings Addressed in Lesson:

1. The skin is a dynamic organ that functions in protection, temperature regulation, sensation, excretion, and absorption in the human body.
2. Burn damage to skin can impact numerous body functions and body systems.
3. Both the body's ability to sense pain and to suppress pain help protect the human body from injury and death.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that the skin is composed of two main layers, the epidermis and the dermis, and contains accessory organs such as sweat glands and hair follicles.
- Explain how different degrees of burns damage layers of the skin.
- Explain how the human body senses and processes signals of pain.
- Interpret how burn damage to the skin will affect the function of the organ and overall homeostasis in the body.
- Outline what happens inside the body when a person feels pain.

Lesson 2: Bones (8 Days)

Understandings Addressed in Lesson:

1. Bones assist muscles with movement of the body and protect the internal organs from damage and injury.
2. Damage to bone, through a sprain or a fracture, can impact the function of other body organs and systems.
3. Osteoclasts and osteoblasts are specialized bone cells that function to break down old bone tissue and replace it with new.
4. Bone is constantly being broken down and reformed through the process of bone remodeling.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recall the four main types of bone.
- Recognize that bone is a living connective tissue composed of cells and protein fibers wrapped in hard mineral salts that can adapt and change to fit the needs of the person.
- Describe the structure and function of compact and spongy bone. U1
- Describe the types of bone fractures.
- Analyze bone structure using a microscope.
- Interpret X-rays to determine specific types of bone fractures.
- Apply knowledge of hormones and of bone remodeling to explain calcium balance in the body.
- Diagram the stages of bone healing after injury.

Lesson 3: Lymph and Blood Cells (8 Days)

Understandings Addressed in Lesson:

1. The lymphatic and immune system functions to drain and distribute fluid in the body as well as protect the human body against specific invaders.
2. Antibodies are proteins found in the blood or lymph that seek out and bind to specific antigens.
3. Only certain blood types are compatible with one another and can be safely transferred from person to person in a transfusion.

4. Antibodies are produced in response to specific pathogens.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the structure and function of the lymphatic and immune system.
- Recognize that a type of white blood cell called B lymphocyte is responsible for the production of antibodies and has the ability to remember invaders once they have entered the body.
- Recognize that blood type is determined by the antigens present on red blood cells.
- Describe the genetics of blood type.
- Describe the interaction between antigens and antibodies.
- Use information presented in a computer animation to create a flow chart of immune response to a common cold.
- Analyze simulated blood samples to determine blood type.
- Produce and analyze a family pedigree for blood type and determine potential donors for a transfusion.
- Graph and interpret antibody data collected after an infection and relate this data to the response of body cells.
- Diagram an immune response to a common cold.
- Apply knowledge of specific immunity to deduce how vaccines function.

Unit Six – Homeostasis

Time Days (14 Days)

Lesson 1: Health and Wellness (14 Days)

Understandings Addressed in Lesson:

1. Factors in the external environment affect the body's internal environment and overall ability to maintain homeostasis.
2. Human body systems work together to defend against disease and injury and to maintain health and wellness.
3. Medical interventions, measures that improve health or alter the course of a disease, include preventative measures, diagnostic tests, treatments, and rehabilitation.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe how the body systems respond to extreme external environments.

- Explain how the systems work together to maintain homeostasis in the body and to complete basic functions such as movement and communication.
- Illustrate disease in the human body, from its initial symptoms to eventual diagnosis and treatment.
- Interpret knowledge of homeostasis in the body to design an innovative medical intervention or invention.
- Trace disease in human systems by generating a fictional case study and compiling a patient case file.

Medical Interventions Detailed Outline

Unit One: How to Fight Infection
Time Days (45 Days)

Lesson 1.1: The Mystery Infection (17 Days)

Understandings Addressed in Lesson:

1. Medical interventions help maintain health and homeostasis in the body.
2. A variety of methods can be used to detect and/or identify infectious agents.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that medical interventions are measures to improve health or alter the course of an illness and can be used to prevent, diagnose, and treat disease.
- Describe how bioinformatics, the collection, classification, storage, and analysis of biochemical and biological information using computers, can be used to identify disease pathogens.
- Describe the applications of bioinformatics in health and wellness.
- Recognize that diagnostic tests for infectious diseases can provide qualitative results, indicating the presence or absence of disease, as well as quantitative results, indicating the concentration of the infectious agent or of an antibody produced in response to the disease agent.
- Explain the principles of the Enzyme-linked Immunosorbant Assay (ELISA) test and describe how antibodies can be used to detect disease.
- Analyze connections between individuals in a disease outbreak.
- Use publically available molecular databases to search for DNA sequences and identify pathogens.
- Compute serial dilutions and calculate resultant concentrations.
- Perform ELISA testing to determine the concentration of infectious bacteria in simulated body fluids and identify infected patients.

Lesson 1.2: Antibiotic Treatment (9 Days)

Understandings Addressed in Lesson:

1. Antibiotics disrupt the pathways that bacteria use to survive.

2. Bacterial cells use multiple pathways to gain resistance to antibiotics.
3. Overuse and misuse of antibiotics will promote the selection of resistant bacteria.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Label the structures of a bacterial cell.
- Explain the method of action for different classes of antibiotics.
- Describe the pathways through which bacterial cells transfer genes.
- Explain the importance of taking antibiotics as prescribed.
- Use proper laboratory techniques to "mate" a streptomycin resistant strain of E. coli with an ampicillin resistant strain of E. coli.
- Simulate the effects of antibiotics on a bacterial population during an infection.
- Simulate the effect of a missed dose of antibiotics on a bacterial population during an infection.

Lesson 1.3: The Aftermath: Hearing Loss (10 Days)

Understandings Addressed in Lesson:

1. Problems with one or more structures within the ear cause various types of hearing loss.
2. There are a variety of interventions available to help people with hearing loss.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Identify the structures of the ear and describe their function in hearing.
- Describe the pathway of sound vibrations from the time a sound is generated to the time the brain registers the sound.
- Recognize that there are bioethical concerns and considerations related to the use of cochlear implant technology.
- Demonstrate sensorineural versus conductive hearing loss on a model of the ear.
- Perform several simple tests, such as Rinne Test and the Pure Tone Test, to evaluate hearing.
- Interpret audiograms to identify different types of hearing loss.
- Recommend the most appropriate type of intervention for a patient with hearing loss, given the patient's audiogram.

Lesson 1.4: Vaccination (9 Days)

Understandings Addressed in Lesson:

3. Vaccines are medical interventions that activate the immune system to recognize a disease antigen and produce antibodies necessary to defend the body.
4. Vaccines can be produced in the laboratory by various methods, including recombinant DNA techniques.
5. Epidemiologists are dedicated medical professionals at the heart of the public health field who monitor the health of human populations, search for patterns in the development of both infectious and chronic illnesses, assist in outbreak investigations, and design disease treatment and prevention strategies.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe how vaccines interact with the human immune system.
- Recognize that many diseases have been eradicated by large-scale vaccination campaigns.
- Describe the various laboratory methods that are used to manufacture vaccines.
- Recognize that plasmids can be employed as an important tool in genetic engineering and can serve as vectors, vehicles for the movement of genetic information.
- Explain how molecular tools such as ligase and restriction enzymes are used to cut and paste DNA from different sources.
- Describe how recombinant DNA technology can be used to produce vaccines.
- Identify the appropriate steps in an outbreak investigation.
- Assume the role of an epidemiologist to analyze disease data, design an epidemiologic study, and evaluate prevention and therapy for chronic and infectious diseases.

Unit 2: How to Screen What Is In Your Genes
Time Days (23 Days)

Lesson 2.1: Genetic Testing and Screening (16 Days)

Understandings Addressed in Lesson:

1. Genetic testing is the use of molecular methods to determine if someone has a genetic disorder, will develop one, or is a carrier of a genetic illness and involves sampling a person's DNA and examining the chromosomes or genes for abnormalities.
2. Genetic counseling can help a family understand the risks of having a child with a genetic disorder, the medical facts about an already diagnosed condition, and other information necessary for a person or a couple to make decisions suitable to their cultural, religious, and moral beliefs.

3. Proper prenatal care and monitoring of the fetus are vital to maternal and child health during a pregnancy.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that the polymerase chain reaction (PCR) is a laboratory procedure that produces multiple copies of a specific DNA sequence.
- Explain how single base pair changes called single nucleotide polymorphisms (SNPs) can be identified through genetic testing and often correlate to specific diseases or traits.
- Describe proper prenatal care and the medical interventions that function to monitor a pregnancy.
- Compare the process of amniocentesis and chorionic villus sampling.
- Analyze a genetic counseling case file and provide feedback regarding potential genetic outcomes.
- Use laboratory techniques such as DNA extraction, PCR, and restriction analysis to identify single base pair differences in DNA.
- Analyze genetic testing results to predict phenotype.
- Analyze a karyotype.

Lesson 2.2: Our Genetic Future (7 Days)

Understandings Addressed in Lesson:

1. Gene therapy is a type of disease treatment in which faulty genes are replaced by functional copies.
2. Advances in reproductive technology open many moral, ethical, and scientific debates.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Explain how gene therapy can treat a genetic disorder.
- Recognize that various vectors, including viruses, can be used to transfer DNA into human cells.
- Explain how both sperm sorting and embryo selection by preimplantation genetic diagnosis (PDG) provide parents the option to select the gender of a child.
- Outline the process of reproductive cloning.
- Debate the safety and overall effectiveness of gene therapy.
- Defend an argument governing future gene therapy research.

Unit Three: How to Conquer Cancer
Time Days (58 Days)

Lesson 3.1: Detecting Cancer (15 Days)

Understandings Addressed in Lesson:

1. Cancer is a term used for more than 100 different diseases in which cell regulation genes are mutated causing the cells to reproduce out of control.
2. X-rays, CT scans, and MRI scans are used to create pictures of the inside of the body to diagnose and treat many disorders.
3. Scientists use DNA microarray technology to determine the differences in gene expression between different tissue samples.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that there are many different types of cancer, each with specific risk factors, manifestations in the body, and treatment options.
- Describe the different uses for X-rays, CT scans, and MRIs as well as how each technology works.
- Describe the differences in the appearance of normal cells and cancer cells.
- Recognize that DNA microarrays measure the amount of mRNA for genes that is present in a cell sample.
- Use a microscope to compare normal cells and cancer cells.
- Perform a simulated DNA microarray to analyze gene expression patterns.
- Calculate the correlation coefficient for gene expression patterns between different individuals.

Lesson 3.2: Reducing Cancer Risk (17 Days)

Understandings Addressed in Lesson:

1. Behavioral, biological, environmental, and genetic risk factors increase the chance that a person will develop cancer.
2. The risk for developing many cancers can be reduced with life-style changes.
3. Molecular diagnostic tests, such as marker analysis, can be used to detect inherited genetic mutations associated with certain cancers and can be used to predict risk for developing those cancers.
4. Viruses insert their DNA or RNA into a host cell, causing the host cell's genes to mutate which can sometimes cause the cell to become cancerous.
5. Routine cancer screenings can prevent certain types of cancer or can increase the chance that cancer is detected at an early stage when treatment is more effective.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the potential risk factors for different types of cancer as well as the way to reduce the risk.
- Recognize that all external variables in an experiment need to be controlled.
- Recognize that viruses can insert their DNA or RNA into a host cell, causing the host cell's genes to mutate which can sometimes cause the cell to become cancerous.
- List and describe the routine cancer screenings a person should have performed throughout his or her life.
- Design a controlled experiment.
- Graph and analyze experimental data.
- Perform marker analysis to determine the presence of a genetic mutation associated with breast cancer.

Lesson 3.3: Treating Cancer (12 Days)

Understandings Addressed in Lesson:

1. Various methods are used to treat cancer.
2. Various biomedical science disciplines and professionals help patients cope with cancer or the side effects of cancer treatment.
3. Experiments are designed to find answers to testable questions.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that chemotherapy and radiation therapy are cancer treatments that work to destroy cancer cells by stopping or slowing their growth; both treatments can cause negative side effects to the patient.
- Describe how specific chemotherapy drugs interact with and destroy cancer cells.
- Recognize that biofeedback therapy is a technique in which patients are trained to improve their health or manage pain by learning to control certain internal bodily processes that normally occur involuntarily, such as heart rate, respiration rate, and skin temperature.
- Recognize that artificial limbs are built to allow patients who have suffered from the loss of a limb to regain lost function.
- Describe how myoelectric prosthetic limbs work.
- Recognize that physical and occupational therapists work to help patients with disabilities or patients recovering from surgery or injury to restore function, improve mobility, relieve pain, and improve the ability to perform the tasks necessary to lead an independent and productive life.

- Design a controlled experiment to test the effect of relaxation techniques on their heart rate, respiration rate, and skin temperature.
- Analyze experimental data.
- Design and create a simple functioning model of an arm.
- Design and present a comprehensive rehabilitation plan, given a specific case.

Lesson 3.4: Building a Better Cancer Treatment (14 Days)

Understandings Addressed in Lesson:

1. The field of pharmacogenetics investigates how genetic variations correlate with responses to specific medication and strives to develop medical treatments tailored to the individual.
2. Nanotechnology is a field of science that can be applied to health and medicine.
3. Clinical trials are biomedical or health-related research studies that investigate how a new medicine or treatment works in human beings.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that all drugs do not act the same way for all individuals.
- Explain how single nucleotide polymorphism (SNP) profiles may factor in to the decision to prescribe a specific medication.
- Recognize that nanomedicine shows great promise, particularly for cancer research, in the hope that medical interventions can be developed at the cellular and molecular scale to diagnose and treat disease.
- Describe the size of the nanoscale.
- Recognize that clinical trials are regulated by strict guidelines that ensure data collected is valid and human subjects are treated ethically.
- Explain why controlled, randomized, double-blind studies are considered the gold standard for clinical trials.
- Complete an alignment to arrange DNA sequences side-by-side to locate any base pair differences between different individuals.
- Use patients' SNP profiles to predict how they will respond to particular medicines.
- Develop and present a clinical trial proposal for a nanotechnology-based cancer treatment.

Unit Four: How to Prevail When Organs Fail
Time Days (49 Days)

Lesson 4.1: Manufacturing Human Proteins (20 Days)

Understandings Addressed in Lesson:

1. The methods used to diagnose and treat diabetes have changed dramatically over the last 200 years, including the use and production of insulin.
2. Recombinant DNA technology allows scientists to custom-design bacteria that can produce a variety of important protein products, including insulin.
3. Amino acid interactions affect the structure and function of proteins.
4. Proteins in a mixture can be separated by various laboratory techniques.
5. Numerous biomedical professionals assist with the production, distribution, and marketing of a new pharmaceutical or bioengineered product.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the evolution of the methods used to diagnose and treat diabetes from the 1800s through today.
- Explain how plasmids, rings of DNA containing genes of interest, can be inserted into bacteria cells via the process of bacterial transformation.
- Outline the process of bacterial transformation.
- Recognize that chromatography is a technique used to separate components of a mixture and can be used to separate proteins based on the properties of their side chains.
- Recognize that electrophoresis can be used to separate proteins in a mixture and determine the purity of a sample.
- Outline the steps required to produce a protein in the laboratory and describe the role of biomedical professionals along this processing path.
- Insert plasmid DNA into bacterial cells in the laboratory and observe how this genetic information relates to new traits of the bacteria.
- Calculate transformation efficiency to determine the success of a laboratory experiment.
- Demonstrates how amino acids interact using a protein model.
- Isolate a protein based on its chemical properties using column chromatography.
- Analyze results of a bacterial transformation and a protein purification laboratory.
- Set up and run protein gel electrophoresis to test the purity of a protein sample.

  Graph electrophoresis results to determine the molecular weight of an unknown protein.

Lesson 4.2: Organ Failure (3 Days)

Understandings Addressed In Lesson:

1. When the kidneys are not functioning properly, they will not filter adequately. Harmful waste products such as urea, creatinine, and blood urea nitrogen build up in the blood stream, which causes the body to make fewer red blood cells due to the lack of the hormone erythropoietin.
2. Dialysis is an artificial process that removes waste products and excess water from the blood when the kidneys can no longer function.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that end stage renal failure is diagnosed when a patient loses 85 to 90 percent of his/her normal kidney function.
- Explain how dialysis machines work to remove wastes from the blood and adjust fluid and electrolyte imbalances.
- Analyze patient symptoms and laboratory results to diagnose a patient and make treatment recommendations.
- Analyze the pros and cons of hemodialysis, peritoneal dialysis, and kidney transplant for a patient with end stage renal disease.

Lesson 4.3: Transplant (15 Days)

Understandings Addressed in Lesson:

1. Deciding who receives donated organs is not always a clear-cut issue and involves many difficult decisions guided by federal policies.
2. In organ transplantation, the organ donor and recipient need to have compatible blood and tissue types.
3. Organ transplant surgery is a complex procedure involving various surgical techniques and a variety of biomedical science professionals.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that the surgical techniques involved in a live donor kidney transplant require skill, dexterity, and eye-hand coordination.
- Recognize that there are many similarities and differences between a heart transplant and a kidney transplant.
- Use federal policy guidelines to defend who should receive a donated organ in a given situation.
- Use blood typing and HLA typing results to determine to match an organ donor with a compatible recipient.
- Perform simulated laparoscopic and general surgical techniques.

Lesson 4.4: Building a Better Body (11 Days)

Understandings Addressed in Lesson:

1. A variety of tissues and organs can be transplanted from one person to another.
2. Scientific research is investigating the possibility of replacing damaged organs and tissues using xenotransplantation and tissue engineering.
3. Advancing medical knowledge and technology will enable scientists to enhance the human body.
4. Scientists need to make sure that what they present is accurate and is communicated in a way that keeps interest and focus.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Identify which tissues and organs can be transplanted from one person to another.
- Describe how xenotransplantation or tissue engineering work, as well as their potential risks, benefits, challenges, and ethical or moral concerns.
- Defend arguments as to whether or not further research for xenotransplantation and tissue engineering should be banned.
- Evaluate the effectiveness of different body parts and functions and design enhancements and/or replacements to make the human body more efficient.

Biomedical Innovation Detailed Outline

Problem One: Design of an Effective Emergency Room
Time Days (24 Days)

Understandings Addressed in Lesson:

1. Biomedical innovation is vital to treating disease and disability and to prolonging life in the face of illness and injury.
2. Internet and print resources must be evaluated for accurate content and reliability.
3. Producing effective presentations of scientific material relies on accurate content, effective delivery, and if applicable, visuals that support the key points.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe unique solutions to the health and medical problems of this century.
- Describe the design of effective oral and visual presentations.
- Recognize that innovations in healthcare and medicine can help reduce wait time and promote efficient care in emergency rooms and emergency care centers.
- Assess web resources for credibility.
- Use online search engines and journal databases to locate scientific articles.
- Analyze the format of a presentation and list strengths and weaknesses in design.
- Design an efficient emergency room or department.
- Produce a Gantt chart to manage the work of a design project.
- Deliver an effective formal presentation.

Problem Two: Exploring Human Physiology
Time Days (23 Days)

Understandings Addressed in Lesson:

1. A variety of research study designs can be used to find answers to testable questions.

2. Experiments are designed to find answers to testable questions.
3. Scientists use various statistical analysis methods to draw meaningful conclusions from experimental results.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that statistics can be used inappropriately to manipulate data and/or mislead readers.
- Recognize that research results presented in the popular media differ from research results presented in scientific literature.
- Write a brief study design to investigate the association between an activity/treatment and disease pair. U1
- Complete statistical analysis for an assigned study.
- Design a controlled experiment.
- Design, conduct, and analyze an experimental study to find the answer to a question relating to one or multiple body systems.
- Create and present a poster presentation to display results of an experimental study.

Problem Three: Design of a Medical Innovation
Time Days (16 Days)

Understandings Addressed in Lesson:

1. The design process is a series of steps used to design a new product or system.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Describe the evolution of various biomedical products, such as an insulin pump or artificial skin.
- Recognize that when designing a solution to a problem, all criteria need to be specified and all possible designs need to be explored.
- Develop ideas for a new biomedical product or for a way to improve an existing product.
- Research and compile information about a chosen problem and evaluate solutions of the past and present.
- Explore possible design solutions, select the best approach, and develop a design proposal.
- Create a model, prototype, or schematic for the chosen solution.

Problem Four: Investigating Environmental Health

Time Days (25 Days)

Understandings Addressed in Lesson:

1. The field of environmental health focuses on the connections between human wellbeing and the conditions in the environment.
2. Water can be contaminated by a wide variety of chemicals and biological agents that have health implications for humans and animals; such contaminants can be tested for using specific assays.
3. The effect a chemical has on an organism is related to its dose and the resulting concentration of the chemical in the body.
4. Experiments are designed to find answers to testable questions.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify environmental concerns potentially harmful to health.
- Recognize that the presence of coliform in water indicates contamination with human or animal fecal material and that disease-causing agents may be present.
- Explain how various factors affect how individuals respond to a given toxin.
- Recognize that an environmental health profile outlines the quality of the local environment and the health of local residents.
- Perform and analyze a culture assay to detect coliform and E. Coli in water.
- Use PCR and gel electrophoresis to determine which bacterial strain is present in a simulated water sample.
- Use a variety of chemical assays to detect specific contaminants in water samples.
- Design and conduct an experiment to test the effects of a particular chemical and doses of that chemical on plant growth.
- Graph and analyze a dose-response curve.
- Compile a comprehensive environmental health profile for the local area.
- Design an action plan to increase awareness, monitor resources or individuals in the community, improve conditions, and ensure a clean and safe environment.

Problem Five: Combating a Public Health Issue
Time Days (18 Days)

Understandings Addressed in Lesson:

1. Epidemiologists or other public health investigators analyze patient symptoms, results of diagnostic tests, and other clues relevant to person,

place, and time of the outbreak to successfully pinpoint the specific nature of the disease as well as a source.

2. Public health intervention plans may include education efforts, screening and diagnosis, treatment, distribution of medication or vaccinations, and research.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that measures of association such as relative risk and the odds ratio describe the correlation between specific risk factors and the development of disease.
- Describe how to set up case-control and cohort studies.
- Recognize local, national, and global disease trends.
- Analyze evidence documents to determine the source of a disease outbreak.
- Calculate measures of risk used to demonstrate a possible association between a risk factor and a disease.
- Write a grant proposal outlining an intervention plan for a particular disease, illness, or injury.
- Present and defend an intervention plan to a professional audience.

Problem Six: Molecular Biology in Action (Optional) Time Days (19 or 45 Days)

Understandings Addressed in Lesson:

1. Plasmids can be used to assemble recombinant DNA and clone a gene of interest.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that plasmids, circular rings of DNA, that are cut with restriction enzymes can be joined or ligated to DNA (from any species) that has been cut with the same enzyme.
- Recognize that the DNA inserted into a plasmid may provide the code for a new protein.
- Recognize that the results of a ligation experiment can be gauged by restriction analysis of an extracted plasmid and subsequent visualization of resultant bands via electrophoresis.
- Map a plasmid in terms of the location of their restriction sites, sites that are recognized and cut by specific restriction enzymes.
- Predict the results of a ligation experiment.
- Ligate DNA from two organisms to create a unique plasmid vector.
- Insert a new plasmid into bacterial cells through the process of bacterial transformation.

- Isolate the plasmid DNA from the bacterial cells and analyze the composition of the plasmid using restriction enzymes and gel electrophoresis.
- Analyze a gene sequence using bioinformatics tools and databases (optional).

Problem Seven: Forensic Autopsy (Optional)
Time Days (12 Days)

Understandings Addressed in Lesson:

1. External and internal investigations of the body during an autopsy allow forensic pathologists to determine the cause of death.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that size measurements and weights of organs are used in an autopsy to determine any abnormalities.
- Recognize that whether cause of death is natural, accident, or homicide, the body leaves clues to tell the story of how a person died.
- Complete a fetal pig autopsy using the same protocol used for humans, including examination of the tissues, organs, systems, and body fluids.
- Create a fictitious death scenario, including an autopsy report and medical history forms, to illustrate cause of death.
- Analyze a fictitious death scenario, including an autopsy report and medical history forms, to determine cause of death.

Problem Eight: Independent Project (Optional)
Time Days (24+ Days)

Understandings Addressed in Lesson:

1. A long-term project requires planning in order to have the proper materials and to schedule the work to be completed in time.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that breaking a large project into many smaller tasks allows for modifications to be made as necessary and serves as a means to monitor progress toward completion of the project.
- Use appropriate Internet search techniques to gather information about a topic from appropriate websites.

- Develop a proposal for an independent project.
- Establish a protocol, timeline, and a means to measure progress toward completion of the project.
- Complete an independent project, including making a product, writing a report, compiling a portfolio, and delivering an oral presentation.