Biomedical Science
14255

Rationale Statement:
This course provides an introduction to the biomedical sciences through exciting hands-on projects and problems. Students investigate the human body systems and various health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. They determine the factors that led to the death of a fictional person, and investigate lifestyle choices and medical treatments that might have prolonged the person's life. The activities and projects introduce students to human physiology, medicine, research processes and bioinformatics. Key biological concepts including homeostasis, metabolism, inheritance of traits, and defense against disease are embedded in the curriculum. Engineering principles including the design process, feedback loops, and the relationship of structure to function are also incorporated. This course is designed to provide an overview of all the courses in the Biomedical Sciences program and lay the scientific foundation for subsequent courses.

Suggested grade level: Grades 9 or 10

Topics covered:
The Mystery: forensics; DNA analysis; experimental design
Diabetes: biochemistry; disease diagnosis; endocrine system; grant writing
Sickle Cell Disease: DNA structure; protein synthesis; genetics; HIPAA
Heart Disease: cardiovascular structure and function; hypercholesterolemia; PCR; gel electrophoresis; pharmacology
Infectious Disease: microbiology; virology; epidemiology; public health
Post Mortem: introduction to human body systems

Indicator #1: The Mystery: forensics; experimental design	
Webb's Leveling	Standard and Examples
Recall	**PBS 1.1** Investigate methods used to analyze DNA.
Recall	**PBS 1.2** Complete career journal entries of various careers associated with death.
Recall	**PBS 1.3** Explore the science of autopsies.
Skill/Concept	**PBS 1.4** Process crime scene for clues to a mysterious death.
Skill/Concept	**PBS 1.5** Explore the relationship between DNA, genes, and chromosomes.
Skill/Concept	**PBS 1.6** Build a model of the DNA molecule and be able to

	use appropriate vocabulary to describe its structure.
Skill/Concept	**PBS 1.7** Extract DNA from plant and animal cells.
Skill/Concept	**PBS 1.8** Investigate the structural components of DNA by building a three-dimensional model of the molecule.
Strategic Thinking	**PBS 1.9** Analyze evidence collected at the crime scene.
Strategic Thinking	**PBS 1.10** Compare DNA found at the crime scene to various suspects.
Strategic Thinking	**PBS 1.11** Draw conclusions about the manner of death in this mystery.
Extended Thinking	**PBS 1.12** Design an experiment to investigate how height or surface materials affect blood patterns.

Indicator #2: Diabetes: biochemistry; disease diagnosis; feedback loops; grant writing	
Webb's Leveling	Standard and Examples
Recall	**PBS 2.1** Explain the causes, symptoms, effects, and treatments of both Type I and Type II diabetes.
Recall	**PBS 2.2** Demonstrate an understanding of the ways in which diabetes can impact one's daily life.
Recall	**PBS 2.3** Describe behaviors that could help prevent the onset of Type II diabetes.
Recall	**PBS 2.4** Explain why water is an essential component of human bodies.
Skill/Concept	**PBS 2.5** Model dehydration synthesis and hydrolysis using two-dimensional models of carbohydrates, proteins and lipids.
Skill/Concept	**PBS 2.6** Complete a dialysis tubing experiment to explore what happens to a diabetic's cells.
Skill/Concept	**PBS 2.7** Explore how to locate credible sources for scientific research.
Skill/Concept	**PBS 2.8** Explain how feedback systems are used by the human body to maintain homeostasis
Skill/Concept	**PBS 2.9** Investigate feedback loops and explore the feedback relationship of insulin and glucose.
Skill/Concept	**PBS 2.10** Analyze food labels for nutritional content.
Skill/Concept	**PBS 2.11** Differentiate between the classes of macromolecules in terms of their structures and functions.

Strategic Thinking	**PBS 2.12** Complete laboratory tests to diagnose fictitious patients with diabetes.
Strategic Thinking	**PBS 2.13** Complete a laboratory experiment to match patients' serum levels with the correct blood sugar levels.
Strategic Thinking	**PBS 2.14** Use calorimetry to measure the amount of energy in a food.
Strategic Thinking	**PBS 2.15** Use organic indicator to identify chemical compounds in various foods.
Extended Thinking	**PBS 2.16** Design a three-dimensional working model to show how insulin is needed to move glucose into cells.
Extended Thinking	**PBS 2.17** Devise an innovation involved in the diagnosis, treatment, and monitoring of diabetes.
Extended Thinking	**PBS 2.18** Present the innovation projects in the form of a grant proposal and presentation.

Indicator #3: Sickle Cell Disease: DNA structure; protein synthesis; genetics; HIPAA	
Webb's Leveling	Standard and Examples
Recall	**PBS 3.1** Use appropriate Internet research techniques to obtain information on the relationship between sickle cell carriers and malaria resistance.
Recall	**PBS 3.2** Explore the process of protein synthesis through various interactive tutorials.
Skill/Concept	**PBS 3.3** Use proper microscope technique to examine and record observations of normal and sickle red blood cells
Skill/Concept	**PBS 3.4** Complete a hematocrit in order to determine if a patient has anemia.
Skill/Concept	**PBS 3.5** Fill in a concept map outlining the process of protein synthesis.
Skill/Concept	**PBS 3.6** Calculate the probability of a trait appearing in offspring.
Skill/Concept	**PBS 3.7** Use proper laboratory techniques to create and analyze a chromosome spread of human HeLa cells.
Skill/Concept	**PBS 3.8** Research HIPAA laws and discuss whether HIPAA was broken or not in various scenarios.
Strategic	**PBS 3.9** Apply knowledge of protein synthesis in order to

Thinking	decode a secret message.
Strategic Thinking	**PBS 3.10** Use computer-modeling software to investigate the effects that various mutations have on protein production, specifically the sickle cell mutation.
Strategic Thinking	**PBS 3.11** Create and analyze pedigree charts to illustrate passage of a trait through at least three generations.
Strategic Thinking	**PBS 3.12** Research the history of HeLa cells and discuss the ethics surrounding the commodification of human body parts.
Strategic Thinking	**PBS 3.13** Analyze gel electrophoresis pictures to determine a patient's genotype for sickle cell mutation.
Extended Thinking	**PBS 3.14** Write diary entries detailing a sickle cell patient's treatment options and evaluate the risks and benefits of these options.
Extended Thinking	**PBS 3.15** Design a protein with a specific function by specifying the sequence of nucleotides in the protein's gene.

Indicator #4: Heart Disease: cardiovascular structure and function; hypercholesterolemia; PCR; gel electrophoresis; pharmacology	
Webb's Leveling	Standard and Examples
Recall	**PBS 4.1** Create two dimensional drawings of the human heart labeling all important structures.
Recall	**PBS 4.2** Discuss the background of laboratory tools such as polymerase chain reaction, restriction enzymes, and gel electrophoresis.
Recall	**PBS 4.3** Investigate the role that blood pressure and cholesterol lowering medications play in treating heart disease.
Skill/Concept	**PBS 4.4** Dissect a sheep's heart, accurately identifying and describing the function of the specified structures.
Skill/Concept	**PBS 4.5** Compare and contrast the characteristics of the different cardiac tissue types using a microscope.
Skill/Concept	**PBS 4.6** Identify, sketch, and measure red and white blood cells viewed under a microscope.
Skill/Concept	**PBS 4.7** Create a product informing other students about HDL and LDL and how these molecules are associated with the risk for heart disease.

Skill/Concept	**PBS 4.8** Complete a laboratory exercise to test patients' blood for cholesterol levels.
Skill/Concept	**PBS 4.9** Calculate and graph the amplification of DNA during the polymerase chain reaction.
Skill/Concept	**PBS 4.10** Use proper laboratory techniques to separate DNA fragments by gel electrophoresis.
Strategic Thinking	**PBS 4.11** Explain how the design of the four-chambered heart allows the heart to pump both oxygenated and un-oxygenated blood without mixing.
Strategic Thinking	**PBS 4.12** Collect and analyze EKG data.
Strategic Thinking	**PBS 4.13** Modify vessel lengths and/or widths to determine how these modifications change the flow of blood through the heart.
Strategic Thinking	**PBS 4.14** Build a pump that successfully moves 150 mL of water from one location to another.
Strategic Thinking	**PBS 4.15** Use the Experimental Design Process to create and carry out experiments on blood pressure and heart rate.
Strategic Thinking	**PBS 4.16** Create a board game that demonstrates the steps or stages in the development, trial, and approval of pharmaceuticals.
Extended Thinking	**PBS 4.17** Complete a formal lab report to explain the results of the heart rate or blood pressure experiment.
Extended Thinking	**PBS 4.18** Create a model to demonstrate various heart blockages and use this model to demonstrate different treatment techniques to unblock vessels.

Indicator #5: Infectious Disease: microbiology; virology; epidemiology; public health	
Webb's Leveling	Standard and Examples
Skill/Concept	**PBS 5.1** Properly streak and culture different strains of bacteria.
Skill/Concept	**PBS 5.2** Use proper aseptic technique to sample and transfer bacterial cells to microscope slides.
Skill/Concept	**PBS 5.3** Complete an experiment to visualize the chain of infection.

Skill/Concept	**PBS 5.4** Build an accurate, labeled, and scaled model of a virus particle.
Strategic Thinking	**PBS 5.5** Use proper Gram staining and microscope techniques to stain, observe, and classify bacteria.
Extended Thinking	**PBS 5.6** Design and produce a Public Health Awareness Campaign to inform people about the cause, symptoms, and prevention of an infectious disease.

Indicator #6: Post Mortem: introduction to human body systems	
Webb's Leveling	Standard and Examples
Recall	**PBS 6.1** Investigate various interventions and treatments that could have prolonged the victim's life.
Strategic Thinking	**PBS 6.2** Showcase ways in which a particular body system has been affected by the diseases studied in this course.
Strategic Thinking	**PBS 6.3** Determine original victim's cause of death.