Orange Public Schools

Office of STEM-Focused Learning

Curriculum Guide

PLTW Principles of Biomedical Science

Curriculum Framework

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Principles of Biomedical Science
PLTW Framework
Course Level

PLTW Framework - Overview

PLTW Frameworks are representations of the knowledge, skills, and understandings that empower students to thrive in an evolving world. The PLTW Frameworks define the scope of learning and instruction within the PLTW curricula. The framework structure is organized by four levels of understanding that build upon each other: Knowledge and Skills, Objectives, Domains, and Competencies.

The most fundamental level of learning is defined by course Knowledge and Skills statements. Each Knowledge and Skills statement reflects specifically what students will know and be able to do after they've had the opportunity to learn the course content. Students apply Knowledge and Skills to achieve learning Objectives, which are skills that directly relate to the workplace or applied academic settings. Objectives are organized by higher-level Domains.

Domains are areas of in-demand expertise that an employer in a specific field may seek; they are key understandings and long-term takeaways that go beyond factual knowledge into broader, conceptual comprehension.

At the highest level, Competencies are general characterizations of the transportable skills that benefit students in various professional and academic pursuits. As a whole, the PLTW Frameworks illustrate the deep and relevant learning opportunities students experience from PLTW courses and demonstrate how the courses prepare students for life, not just the next grade level.

To thrive in an evolving world, students need skills that will benefit them regardless of the career path they choose. PLTW Frameworks are organized to showcase alignment to in-demand, transportable skills. This alignment ensures that students learn skills that are increasingly important in the rapidly advancing, innovative workplace.

Competencies (C), Domains (D), Objectives (O), Knowledge and Skills (KS)

C1 Problem Solving and Process Thinking

Strategic and systematic design and inquiry processes guide the development of an effective solution to the problem.

D1 Experimental Design

An experimental design process is a systematic approach to investigate and gain knowledge.

O1.1 Design an experiment that investigates a research question.

KS1.1.1 Develop an experimental protocol that includes a testable hypothesis.

KS1.1.2 Distinguish between the independent and dependent variables.

KS1.1.3 Identify and explain the purpose and importance of experimental controls.

KS1.1.4 Maintain a detailed repeatable account of an experiment in a physical or digital laboratory notebook.

KS1.1.5 Conduct background research using credible sources.

KS1.1.6 Select and utilize appropriate equipment to conduct experiments.

KS1.1.7 Identify a possible source of errors, then redesign and repeat the experiment when appropriate.

KS1.1.8 Communicate the findings of an experiment in oral and written form.

KS1.1.9 Describe why experimental design is a continual process.

O1.2 Collect and analyze data to draw a conclusion.

KS1.2.1 Read and follow established protocols and instructions.

KS1.2.2 Display data appropriately and accurately in digital or written form (graphs, tables, diagrams).

KS1.2.3 Perform necessary data calculations.

KS1.2.4 Draw logical conclusions from experimental data.

D2 Critical and Analytical Thinking

Biomedical science professionals approach complex problems systematically and logically by breaking them into manageable components. They work collaboratively and apply their knowledge and skills to draw well-reasoned conclusions and solutions.

O2.1 Solve a problem using analytical and critical thinking skills.

KS2.1.1 Devise and execute a plan to solve a problem.

KS2.1.2 Obtain and process information from multiple sources.

KS2.1.3 Describe how persistence is a key mind-set when identifying problems and/or pursuing solutions.

KS2.1.4 Outline how different processes inform biomedical science decisions, improve solutions, and inspire new ideas.

KS2.1.5 Evaluate the reliability and credibility of sources when gathering information.

O2.2 Explain the value of diverse perspectives in the problem-solving process.

KS2.2.1 Explain how solutions for complex problems can require input from interdisciplinary collaboration to incorporate a wide range of perspectives and skills.

O2.3 Explain how scientists use calculated risks to increase scientific knowledge.

KS2.3.1 Explain the importance of risk taking in performing experiments and developing solutions.

KS2.3.2 Identify the pros and cons associated with decisions made in biomedical science.

KS2.3.3 Describe how failure, or unexpected results, can produce positive outcomes by improving understanding.

KS2.3.4 Explain how creativity can lead to scientific discovery.

D3 Biomedical Tools and Technology

The practice of biomedical sciences requires the application of common tools, techniques, and technologies to solve problems.

O3.1 Select and use appropriate tools, technology, and/or software for experimental and clinical data collection and analysis.

KS3.1.1 Use appropriate technology (probes and sensors) and software to collect and analyze physiological data, such as heart rate and blood pressure.

KS3.1.2 Describe and identify cell and tissue features in microscope images.

KS3.1.3 Use aseptic techniques for handling, culturing, and analyzing bacteria samples.

KS3.1.4 Conduct gel electrophoresis to separate DNA fragments.

KS3.1.5 Explain how calorimetry is used to analyze the nutritional content of food.

KS3.1.6 Describe how Restriction Fragment Length Polymorphism (RFLP) analysis is used to diagnose genetic disease and disorders.

KS3.1.7 Demonstrate proper usage of a microscope.

C2 Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

D4 Analysis of Medical Evidence

Patient records and other pieces of medical evidence can be used to assess a person's health and identify disease.

O4.1 Analyze medical evidence to draw conclusions.

KS4.1.1 Review a patient's medical history and/or autopsy report to analyze how malfunctions in the body can lead to disease and/or death.

KS4.1.2 Recognize that determining cause of death is a complex investigation process.

KS4.1.3 Review medical information and test results to diagnose a patient.

KS4.1.4 Create and analyze models of biological processes.

D5 Analysis of Diseases

Biomedical scientists understand the symptoms, diagnosis, and treatment of disease to help patients.

O5.1 Explain the signs, symptoms, diagnosis, and treatment of diabetes.

KS5.1.1 Explain the importance of blood glucose regulation in maintaining homeostasis.

KS5.1.2 Differentiate between Type 1 and 2 diabetes.

KS5.1.3 Analyze laboratory insulin and glucose tolerance test results to diagnose Type 1 or 2 diabetes.

KS5.1.4 Describe the effects of diabetic complications on the human body.

KS5.1.5 Describe the impact of lifestyle habits on human health and disease risk.

KS5.1.6 Given patient information, discuss treatment options for diabetes.

KS5.1.7 Compare and contrast hyperglycemia and hypoglycemia.

O5.2 Explain the signs, symptoms, diagnosis, and treatment of sickle cell anemia.

KS5.2.1 Explain the process of diagnosing sickle cell anemia.

KS5.2.2 Analyze the results of the hematocrit test to diagnose anemia.

KS5.2.3 Recognize the causes and symptoms of sickle cell disease.

KS5.2.4 Given patient information, discuss treatment options for sickle cell anemia.

KS5.2.5 Describe the effect of sickle cell anemia complications on the human body.

O5.3 Explain the signs, symptoms, diagnosis, and treatment of heart disease.

KS5.3.1 Describe how internal and external factors can affect heart function and can contribute to the development of heart disease.

KS5.3.2 Describe the use of diagnostic tools in identifying blocked blood vessels.

KS5.3.3 Discuss and evaluate options for treating blocked arteries and preventing other health issues that might occur because of them.

KS5.3.4 Describe the function of HDL and LDL in cholesterol transport and how levels of these molecules relate to heart disease risk.

O5.4 Explain the signs, symptoms, diagnosis, and treatment of infectious diseases.

KS5.4.1 Describe how the immune system responds when an antigen enters the body.

KS5.4.2 Describe the prevention of and treatment for various infectious agents.

D6 Structure and Function

The functions and properties of natural and human-designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.

O6.1 Describe the role of structure and function in biology.

KS6.1.1 Explain how the order and chemical properties of amino acids influence a protein's structure and function.

KS6.1.2 Model the anatomy and physiology of the cardiovascular system.

KS6.1.3 Explain how structures in the body provide protection against pathogens.

KS6.1.4 Explain how the structure of a blood cell affects its ability to carry oxygen.

KS6.1.5 Describe the relationship between insulin, glucagon, and the regulation of blood glucose levels.

KS6.1.6 Identify the structure and function of macromolecules that are used for energy.

D7 Molecular Biology and Genetics

Analyzing DNA offers insight into the causes of genetic diseases.

O7.1 Explain the role of DNA in the body and the inheritance of traits.

KS7.1.1 Describe the structure and function of DNA.

KS7.1.2 Differentiate between mitosis and meiosis.

KS7.1.3 Explain the relationship among genes, alleles, chromosomes, proteins, and traits.

KS7.1.4 Describe the process of protein synthesis.

KS7.1.5 Predict the pattern of gene inheritance using Punnett squares and pedigree analysis.

KS7.1.6 Explain how DNA mutations can lead to sickle cell anemia and hypercholesterolemia.

KS7.1.7 Explain the action of restriction enzymes in processing DNA for analysis.

KS7.1.8 Analyze gel electrophoresis results to draw conclusions, such as diagnosing genetic diseases.

D8 Microbiology

Biomedical scientists study and manipulate microorganisms to understand their properties (i.e., growth and behavior) and their role in infectious disease.

O8.1 Identify the types of pathogens that cause infectious disease.

KS8.1.1 Identify the structures of bacterial cells.

KS8.1.2 Characterize and identify bacteria by their shape, colony morphology, metabolism, and reaction to the Gram stain.

KS8.1.3 Describe the mode of transmission and reproduction of various infectious agents.

C3 Professional Practices and Communication

Professional practice is guided by professional ethics and standards and requires effective communication and collaboration.

D9 Career Awareness

Biomedical science solutions have global impacts in economic, environmental, and societal contexts.

O9.1 Explain the education and skills required for biomedical science professionals.

KS9.1.1 Identify and describe the different careers of professionals who research, diagnose, and treat medical conditions.

KS9.1.2 Describe the education requirements, salary ranges, professional licensure, skills, and responsibilities of biomedical science professionals.

KS9.1.3 Explain the importance of life-long learning for biomedical science professionals.

O9.2 Describe the societal impact of biomedical science professionals.

KS9.2.1 Describe the impact that biomedical science research and interventions have on society, including disease prevention and treatment.

KS9.2.2 Describe the global impact of biomedical science solutions.

D10 Professionalism and Ethics

Successful biomedical scientists typically exhibit specific personal and professional characteristics that lend themselves to the creative, collaborative, and solution driven nature of the profession.

O10.1 Apply professional standards, as they relate to the personal traits of a biomedical science professional.

KS10.1.1 Demonstrate the importance of honesty, integrity, and accountability for biomedical professionals.

KS10.1.2 Create and support an environment that fosters teamwork, emphasizes quality, and promotes learning.

KS10.1.3 Describe the importance of ethical considerations when making biomedical science decisions.

KS10.1.4 Demonstrate the importance of punctuality and meeting deadlines.

O10.2 Explain the importance of patient confidentiality.

KS10.2.1 Communicate the importance of patient privacy.

KS10.2.2 Describe patient privacy rights that are protected by the Health Insurance Portability and Accountability Act (HIPAA).

D11 Communication

Biomedical Science requires effective communication with a variety of audiences using multiple modalities.

O11.1 Communicate effectively with a specific audience.

KS11.1.1 Follow acceptable formats for writing assignments and professional presentations.

KS11.1.2 Modify communications to meet the needs of the audience and be appropriate to the situation.

KS11.1.3 Properly cite references for all reports in an accepted format.

KS11.1.4 Use proper elements of written and electronic communication (spelling, grammar, and formatting).

D12 Collaboration

Being able to effectively and efficiently function on multidisciplinary teams is critical to success in the biomedical sciences.

O12.1 Create an effective team environment to promote successful goal attainment.

KS12.1.1 Respect others' viewpoints.

KS12.1.2 Describe the importance of each team member's contribution to the project.

KS12.1.3 Identify basic conflict resolution strategies and employ those strategies as necessary and appropriate.

KS12.1.4 Use a peer review process to give effective and constructive feedback to given outcomes.