Orange Public Schools

Office of STEM-Focused Learning

Curriculum Guide

PLTW Medical Interventions

Curriculum Framework

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Medical Interventions
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 use appropriate equipment to conduct experiments.

KS1.1.7 Identify possible sources of errors, and when appropriate, redesign and repeat the experiment.

KS1.1.8 Communicate the findings of an experiment in oral and written (including digital) form.

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

O1.2 Collect and analyze data to draw conclusions.

KS1.2.1 Read and follow established protocols and instructions.

KS1.2.2 Display data appropriately and accurately in multiple formats (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.

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

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

KS2.1.2 Obtain and process credible information from various sources.

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

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

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

KS2.2.1 Explain how solutions for complex problems can require 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.

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 Conduct both horizontal (DNA) and vertical (protein) gel electrophoresis.

KS3.1.2 Describe and apply aseptic techniques for handling and culturing microbial samples.

KS3.1.3 Analyze cell and tissue samples using appropriate microscopy skills.

KS3.1.4 Describe the various laboratory methods that are used to manufacture vaccines.

KS3.1.5 Explain the applications of PCR technology as well as the role of each reagent in the process.

KS3.1.6 Select and use appropriate technology (probes and sensors) and software to collect and analyze physiological data.

KS3.1.7 Describe the skill, dexterity, and eye-hand coordination necessary to complete surgical techniques.

KS3.1.8 Explain how DNA microarrays are used to compare gene expression (mRNA expression) between different tissue samples or sample groups.

KS3.1.9 Describe how microarray data can be used to evaluate cancer risks.

KS3.1.10 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 Collect and analyze medical information to evaluate the cause, prevention, and treatment of disease.

KS4.1.1 Analyze connections between patients in an outbreak situation, determine appropriate tests to identify the pathogen, and determine the steps for treatment and containment.

KS4.1.2 Interpret concentration results of a quantitative antigen-based assay for various patients to infer a path of infection.

KS4.1.3 Explain the impact vaccines have had on disease occurrence.

KS4.1.4 Match an organ donor with a compatible recipient based on blood typing and HLA typing results.

KS4.1.5 Explain why controlled, randomized, double-blind studies are considered the gold standard for clinical trials.

KS4.1.6 Analyze patient symptoms and medical evidence to diagnose a fictional patient.

KS4.1.7 Analyze disease data, design epidemiologic studies, and evaluate prevention and therapy for chronic and infectious diseases.

D5 Microbiology

Biomedical scientists study and manipulate microorganisms to study their properties, understand their role in infectious disease, and use them as vectors for genetic engineering.

O5.1 Explain the structure and function of bacterial cells and how antibiotics work to disrupt their growth.

KS5.1.1 Describe the function of the major structures in the bacterial cell and how these structures provide the cell defense.

KS5.1.2 Explain how the four main classes of antibiotics target specific bacterial structures and biological pathways.

KS5.1.3 Compare the three types of bacterial gene transfer and the relationship of this transfer to antibiotic resistance.

KS5.1.4 Describe the ways in which the misuse of antibiotics can impact bacterial growth.

D6 Diagnostic Testing

Biomedical science professionals understand and use diagnostic tests to diagnose disorders and/or disease within the human body.

O6.1 Describe how diagnostic tests are used to assess the health of an individual and/or indicate the presence of disease.

KS6.1.1 Explain the principles of the Enzyme-linked Immunosorbent Assay (ELISA) test and interpret ELISA results to detect the presence and concentration of a pathogen.

KS6.1.2 Determine the appropriate hearing tests to diagnose sensorineural and conductive hearing loss.

KS6.1.3 Interpret audiograms to identify different types of hearing loss and select appropriate interventions.

KS6.1.4 Analyze the difference between normal cells and cancer cells.

KS6.1.5 Describe the different uses for X-rays, bone scans, CT scans, and MRIs, as well as how each technology works.

D7 Disease Physiology

Biomedical science professionals apply their understanding of how malfunction(s) within the body lead to disease, and use this information to identify symptoms, and to diagnose, treat, and prevent disease.

O7.1 Explain the physiological processes associated with disease or injury.

KS7.1.1 Relate the structure of the ear to function and explain the pathophysiology of hearing loss.

KS7.1.2 Connect cell cycle regulatory gene mutations to the development of cancer.

KS7.1.3 Describe the behavioral, biological, environmental, and genetic risk factors that can increase the chance that a person will develop cancer.

KS7.1.4 Evaluate genetic risk factors for cancer using family history and marker analysis.

KS7.1.5 Identify symptoms of End Stage Renal Disease (ESRD).

D8 Disease Prevention and Treatment

Biomedical science professionals design and use medical interventions to improve health or treat disease.

O8.1 Describe how medical interventions are used to improve health or alter the course of an illness.

KS8.1.1 Explain how reproductive technology works.

KS8.1.2 Evaluate the promise and limitations of gene editing.

KS8.1.3 Evaluate the benefits and side effects of cancer treatments.

KS8.1.4 Describe how myoelectric prosthetic limbs work to restore function to patients who have lost a limb.

KS8.1.5 Differentiate between physical and occupational therapy.

KS8.1.6 Analyze the pros and cons of hemodialysis, peritoneal dialysis, and kidney transplant for a patient with ESRD.

KS8.1.7 Explain how biofeedback therapy can improve health and/or manage pain.

KS8.1.8 Describe how vaccinations protect against illness.

D9 Molecular Biology

DNA analysis allows scientists to understand the causes and treatment of genetic disease, identify disease pathogens, as well as biomanufacture protein products.

O9.1 Describe the applications of bioinformatics in health and wellness.

KS9.1.1 Describe how computer database technology can be used to analyze genetic information.

KS9.1.2 Use computer database technology to analyze genetic information and interpret the results.

O9.2 Explain how recombinant DNA technology allows scientists to custom-designed bacteria that can produce a variety of important protein products.

KS9.2.1 Explain how molecular tools, such as ligase and restriction enzymes, are used to cut and paste DNA from different sources.

KS9.2.2 Identify which restriction enzyme to use for a given situation.

KS9.2.3 Outline the steps required to produce a protein in the laboratory.

KS9.2.4 Describe how recombinant DNA technology can be used to produce vaccines.

KS9.2.5 Insert plasmid DNA into bacterial cells in the laboratory and observe how this genetic information relates to new traits of the bacteria.

KS9.2.6 Isolate a protein based on its properties using column chromatography.

KS9.2.7 Verify an isolated protein using protein electrophoresis.

O9.3 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.

KS9.3.1 Identify single base- pair differences in DNA through laboratory techniques, such as DNA extraction, PCR, and restriction analysis.

KS9.3.2 Predict how a person will respond to particular medications based on patient SNP profile.

KS9.3.3 Explain how SNPs can be identified through genetic testing and how they correlate to specific diseases or traits.

O9.4 Describe how genetic counseling can help a family understand the risks of having a child with a genetic disorder, as well as inheritance information about an already diagnosed condition.

KS9.4.1 Interpret karyotype results and determine outcomes and options.

KS9.4.2 Analyze personal and family medical history and genetic testing results to make a recommendation for a particular genetic counseling case.

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

C3 Professional Practices and Communication

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

D10 Career Awareness

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

O10.1 Explain the education and skills required for biomedical science professionals.

KS10.1.1 Identify and describe the different careers of professionals who research, diagnose, and treat medical conditions.

KS10.1.2 Describe the education requirements, salary ranges, professional licensure, skills, and responsibilities for biomedical science professionals.

KS10.1.3 Explain the importance of life-long learning for biomedical science professionals.

KS10.1.4 Apply professional standards, as they relate to the habits and characteristics of a biomedical science professional.

O10.2 Describe the societal impact of biomedical science professionals.

KS10.2.1 Describe the impact that biomedical science research and interventions have on society, including disease diagnosis, prevention, and treatment.

KS10.2.3 Describe the global impact of biomedical science solutions.

D11 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.

O11.1 Apply professional standards, as they relate to the personal traits of a biomedical science professional.

KS11.1.1 Demonstrate the importance of honesty, integrity, and accountability for biomedical professionals.

KS11.1.2 Describe the importance of privacy for all individuals.

KS11.1.3 Create and support an environment that fosters teamwork, emphasizes quality, and promotes learning.

KS11.1.4 Describe the importance of ethical considerations when making biomedical science decisions.

O11.2 Evaluate ethical and moral issues related to various medical interventions.

KS11.2.1 Use Federal policy guidelines to defend who should receive a donated organ in a given situation.

KS11.2.2 Defend arguments as to whether or not further research for xenotransplantation and tissue engineering should be banned.

KS11.2.3 Defend an argument governing future gene editing research.

KS11.2.4 Describe the bioethical concerns and considerations related to the use of cochlear implant technology.

KS11.2.5 Explain why clinical trials are regulated by strict guidelines.

D12 Communication

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

O12.1 Communicate effectively with a specific audience.

KS12.1.1 Follow acceptable formats for writing assignments and professional presentations.

KS12.1.2 Modify communications to meet the needs of the audience and be appropriate to the situation.

KS12.1.3 Properly cite references for all reports in an accepted format.

KS12.1.4 Use proper elements of written communication (spelling, grammar, and formatting).

D13 Collaboration

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

O13.1 Create an effective team environment to promote successful goal attainment.

KS13.1.1 Respect others' viewpoints.

KS13.1.2 Describe the importance of each team member's contribution to the project.

KS13.1.3 Identify basic conflict resolution strategies and employ those strategies as necessary and appropriate.

KS13.1.4 Employ a peer review process to give effective and constructive feedback to meet given outcomes.