

#### 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)

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##### 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 the 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 source of errors, then redesign and repeat the experiment when appropriate.

KS1.1.8 Communicate the findings of the 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 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 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.

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 a microscope to view cell and tissue samples.

KS3.1.2 Explain the steps to conduct gel electrophoresis.

KS3.1.3 Use appropriate tools, such as micropipettes, calipers, and probes, to measure substances and body characteristics.

KS3.1.4 Demonstrate proper usage of a microscope.

KS3.1.5 Use appropriate technology (probes and sensors) and software to collect and analyze physiological data.

**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 and draw a conclusion.

KS4.1.1 Review medical evidence to diagnose a patient and recommend a course of treatment.

KS4.1.2 Describe how features of bone(s) contribute to a person's unique physical identity.

KS4.1.3 Describe the relationship between the length of long bones and the overall height of an individual.

KS4.1.4 Explain how pharmaceuticals interact with body systems.

KS4.1.5 Analyze a patient's metabolic needs, BMR, and BMI to make appropriate recommendations to improve their health.

KS4.1.6 Demonstrate correct use of directional and regional terms to describe location in the human body.

KS4.1.7 Analyze medical data to diagnose lung disorders and design a corresponding treatment plan.

**D5 Analysis of Disease**

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

O5.1 Describe how imbalances in the body system can result in diseases.

KS5.1.1 Explain how events can cause organ system dysfunction and lead to disease.

KS5.1.2 Describe and evaluate medical intervention strategies that can treat or cure diseases.

KS5.1.3 Explain how lifestyle choices can lead to disease.

KS5.1.4 Analyze physical symptoms of a patient and relate these symptoms to errors in hormonal levels.

KS5.1.5 Analyze how structural dysfunction of blood vessels impacts overall health.

KS5.1.6 Interpret how a breakdown in communication in the central nervous system impacts the function of the human body.

**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 Explain how body systems work together to maintain homeostasis.

KS6.1.1 Describe the structure and function of the four types of human tissues.

KS6.1.2 Explain how the body systems respond to extreme conditions and maintain homeostasis.

KS6.1.3 Describe negative feedback loops to demonstrate homeostasis.

O6.2 Describe the structure and function of organ systems that are used for communication.

KS6.2.1 Model the structures and describe the functions of the nervous and endocrine systems, as well as sensory organs such as the eye.

KS6.2.2 Describe the various forms of communication that help the human body interact with the environment, such as processing and responding to sensory information.

KS6.2.3 Compare and contrast chemical and electrical modes of communication.

KS6.2.4 Match regions of the brain with their primary function in the human body.

KS6.2.5 Describe how the movement of ions across the cell membrane of a neuron generates an action potential and propagates electrical signals.

KS6.2.6 Outline what happens in the human body from an initial stimulus to a response in both voluntary and involuntary actions.

KS6.2.7 Explain how the body uses feedback mechanisms to maintain proper levels of hormones for homeostasis.

KS6.2.8 Explain how light is processed differently in a person with normal vision versus a person with myopia or hyperopia.

O6.3 Describe the structure and function of organ systems that provide power.

KS6.3.1 Describe how the digestive, respiratory, and urinary systems work together to power the body.

KS6.3.2 Model the structure and describe the function of the organs in the digestive, respiratory, and urinary systems.

KS6.3.3 Explain how enzymes act on a particular substrate and how their reactions are affected by factors such as temperature and pH.

KS6.3.4 Explain how the function of the lungs facilitates the exchange of oxygen and carbon dioxide between air and the body.

KS6.3.5 Describe the connections between urine and blood and the exchange of ions and fluids that occurs across the nephron.

KS6.3.6 Explain how the roles of macromolecules, oxygen, and water enable the body systems to power the body.

O6.4 Describe the structure and function of organ systems that provide movement.

KS6.4.1 Model the structure and describe the function of the circulatory, respiratory, and muscular systems.

KS6.4.2 Demonstrate or identify types of movement of various joints.

KS6.4.3 Interpret muscle function based on muscle attachment to bone.

KS6.4.4 Explain the mechanisms of muscle contractions.

KS6.4.5 Describe how the body responds to exercise.

O6.5 Describe the structure and function of organ systems that provide protection for the human body.

KS6.5.1 Model the structure and describe the function of the skeletal, integumentary, lymphatic, immune, and nervous systems.

KS6.5.2 Explain the impact of burns on the skin's structure and protective ability.

KS6.5.3 Explain the process of skeletal repair and the types of bone fractures.

KS6.5.4 Explain the action of antibodies in response to antigens.

KS6.5.5 Describe how vaccinations protect against illness.

KS6.5.6 Summarize the role of cell surface molecules in determining capability for blood transfusions.

KS6.5.7 Explain the role of osteoblasts and osteoclasts in bone production and calcium balance in the body.

## D7 Molecular Biology

Analyzing DNA offers insight into the causes of genetic diseases.

O7.1 Describe the process of analyzing DNA.

KS7.1.1 Explain the structure and function of DNA.

KS7.1.2 Explain the action and use of restriction enzymes.

KS7.1.3 Describe how gel electrophoresis can be used to examine DNA differences between individuals.

KS7.1.4 Analyze gel electrophoresis data.

## D8 Clinical Testing

Diagnostic tests can evaluate health and determine whether structures in the body are not properly functioning. Test results aid biomedical professionals in making a diagnosis and recommending a treatment.

O8.1 Explain clinical tests that are used to diagnose malfunctioning organ systems.

KS8.1.1 Describe how clinical diagnostic exams are conducted to determine the health of a body system.

KS8.1.2 Complete and analyze blood test results to determine blood transfusion compatibility.

KS8.1.3 Describe medical interventions that improve human health.

KS8.1.4 Evaluate visual perception by testing depth perception, peripheral vision, color vision, and visual acuity.

KS8.1.5 Analyze spirometry data to determine tidal volume, vital capacity, and minute volume.

KS8.1.6 Analyze urinalysis results to diagnose disease and dysfunction in human body systems.

KS8.1.7 Measure range of motion with a goniometer.

KS8.1.8 Measure peripheral pulses using Doppler ultrasound and calculate an ankle brachial index (ABI).

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

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KS8.1.9 Interpret EMG data to assess muscle fatigue.

KS8.1.10 Interpret X-rays to determine specific types of bone fractures.

KS8.1.11 Interpret coding for prescriptions to understand terminology for pharmacology.

### 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.

KS9.1.4 Demonstrate the importance of punctuality and meeting deadlines.

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.

#### 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 Describe the importance of privacy for all individuals.

KS10.1.3 Create and support an environment that fosters teamwork, emphasizes quality, and promotes learning.

KS10.1.4 Describe the importance of ethical considerations when making biomedical science decisions.

KS10.1.5 Create a professional resume or portfolio for a specified career.

#### 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.

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

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

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