PLTW Biomedical Innovation Course Framework

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.

Essential Questions

1.1 What are the top health-related challenges of the 21st century?

1.2 What process do biomedical scientists follow to solve a problem in health, medicine, or science?

1.3 How can you determine whether the information presented on a website is accurate and credible?

1.4 What factors must be considered when designing and delivering an oral or visual presentation?

1.5 What factors are considered in the triage of patients in an emergency room?

1.6 How can the innovative design of an emergency room help improve the quality and timeliness of medical care?

2.1 How do scientists design research studies to find the most accurate answer to the question they are asking?

2.2 How can statistics be used to manipulate data?

2.3 How do research results presented in the popular media differ from research results presented in scientific literature?

2.4 How do scientists use statistical analyses to draw meaningful conclusions from experimental results?

3.1 How is the design process used to create a new product or system?

3.2 What criteria need to be specified when designing a solution to a problem?

3.3 What factors need to be considered when designing a marketing plan for a new product?

4.1 How does the environment affect human health?

4.2 Why is it important to routinely test water that is used for drinking or recreational purposes?

4.3 What factors affect how individuals respond to a given toxin?

4.4 How can individuals alter their lifestyle to limit human impact on the environment?

4.5 How might a study of trends in health in a particular community identify potential environmental contaminants?

5.1 How do epidemiologists investigate a potential disease outbreak?

5.2 What factors determine when to use a case-control versus a cohort study?

5.3 How does causation differ from correlation?

5.4 How does the distribution of infectious disease and chronic illnesses in a given area relate to lifestyle, culture, and access to medical care?

5.5 What factors determine who receives funding for healthrelated projects or research studies?

6.1 How can plasmids be used in the lab to clone a gene of interest?

6.2 Why are restriction enzymes a fundamental molecular biology tool?

6.3 How might molecular biology shape the future of pharmacology and medicine?

6.4 Is there such a thing as knowing too much about your personal genetic makeup?

7.1 Why are size measurements and weights of organs recorded during an autopsy?

7.2 What clues left behind in the body tell the story of how a person died?

8.1 What should a scientist or medical professional consider before designing and running a biomedical science investigation?

8.2 How might a visual model, such as a Gantt chart, assist in project management?

8.3 Why is it important to document all work when completing a project?

Competencies, Domains, Objectives, Knowledge and Skills

Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Readiness (CAR):

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

CAR-A Demonstrate awareness of the education and skills required for biomedical science professionals.

CAR-A.1 Identify and describe careers of professionals who research, diagnose, and treat medical conditions.

Unit	1	2	3	4	5	6	7	8
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CAR-A.2 Describe the education requirements, salary ranges, professional licensure, skills, and responsibilities of biomedical science professionals.

Unit	1	2	3	4	5	6	7	8
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CAR-A.3 Explain the importance of life-long learning for biomedical science professionals.

Unit	1	2	3	4	5	6	7	8
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CAR-A.4 Apply professional standards, as they relate to the habits and characteristics of a biomedical science professional.

Unit	1	2	3	4	5	6	7	8
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CAR-B Demonstrate awareness of the societal impacts of biomedical science professionals.

CAR-B.1 Describe the impact that biomedical science research and interventions have on disease prevention and treatment.

Unit	1	2	3	4	5	6	7	8
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CAR-B.2 Describe the global impact of biomedical science solutions.

Unit	1	2	3	4	5	6	7	8
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CAR-B.3 Describe the unique solutions to the health and medical problems of this century.

Unit	1	2	3	4	5	6	7	8
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Competencies, Domains, Objectives, Knowledge and Skills

CAR-C Use project management to successfully and efficiently complete tasks as scheduled.

CAR-C.1 Write a proposal for an independent project.

Unit	1	2	3	4	5	6	7	8
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CAR-C.2 Establish a protocol, timeline, and a means to measure progress toward completion of a project.

Unit	1	2	3	4	5	6	7	8
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CAR-C.3 Produce a Gantt chart to manage the work of a project.

Unit	1	2	3	4	5	6	7	8
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CAR-C.4 Research and compile information about a chosen topic.

Unit	1	2	3	4	5	6	7	8
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CAR-C.5 Explain how breaking a large project into many smaller tasks allows modifications to be made as necessary and serves as a means to monitor progress toward completion of the project.

Unit	1	2	3	4	5	6	7	8
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Communication (COM):

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

COM-A Communicate effectively with a specific audience.

COM-A.1 Follow acceptable formats for writing assignments and professional presentations.

Unit	1	2	3	4	5	6	7	8
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COM-A.2 Modify communications to meet the needs of the audience and be appropriate to the situation.

Unit	1	2	3	4	5	6	7	8
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COM-A.3 Properly cite references for all reports in an accepted format.

Unit	1	2	3	4	5	6	7	8
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COM-A.4 Use proper elements of written communication (spelling, grammar, and formatting).

Unit	1	2	3	4	5	6	7	8
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COM-A.8 Write a mini grant to fund a proposal using a specified format (ex: National Institutes of Health).

Unit	1	2	3	4	5	6	7	8
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COM-A.9 Explain the advantages and disadvantages of using online resources.

Unit	1	2	3	4	5	6	7	8
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COM-A.10 Prepare and present a poster on key information from a scientific study.

Unit	1	2	3	4	5	6	7	8
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Collaboration (COL):

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

COL-A Create an effective team environment to promote successful goal attainment.

COL-A.1 Respect others' viewpoints.

Unit	1	2	3	4	5	6	7	8
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COL-A.2 Demonstrate teamwork and describe the importance of each teammember's contribution to the project.

Unit	1	2	3	4	5	6	7	8
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COL-A.3 Identify basic conflict resolution strategies and employ those strategies as necessary and appropriate.

Unit	1	2	3	4	5	6	7	8
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COL-A.4 Employ a peer review process to give effective and constructive feedback to meet given outcomes.

Unit	1	2	3	4	5	6	7	8
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Ethical Reasoning and Mindset (ERM):

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

ERM-A Apply professional standards, as they apply to the habits and characteristics of a biomedical science professional.

ERM-A.1 Demonstrate professional standards, such as creativity, perseverance,honesty, integrity, and accountability, which should be exhibited bybiomedical professionals.

Unit	1	2	3	4	5	6	7	8
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ERM-A.2 Describe the importance of privacy for all individuals.

Unit	1	2	3	4	5	6	7	8
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ERM-A.3 Create and support an environment that fosters teamwork, emphasizes quality, and promotes learning.

Unit	1	2	3	4	5	6	7	8
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ERM-A.5 Describe the ethics of human experimentation and the importance of informed consent.

Unit	1	2	3	4	5	6	7	8
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ERM-A.6 Demonstrate the importance of punctuality and meeting deadlines.

Unit	1	2	3	4	5	6	7	8
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ERM-A.7 Weigh the ethical implications of biomedical science decisions.

Unit	1	2	3	4	5	6	7	8
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Critical and Creative Problem-Solving (CCP):

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.

CCP-A Devise and execute a plan to solve a problem.

CCP-A.1 Synthesize information from multiple credible sources, such as literature, databases, policy documents, and diverse perspectives from multiple disciplines, to explore causes and solutions to problems.

Unit	1	2	3	4	5	6	7	8
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CCP-A.2 Devise and execute a plan to solve a problem while considering the impacts of the possible solutions.

Unit	1	2	3	4	5	6	7	8
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CCP-A.3 Describe how persistence is a key mindset when identifying problems and/or pursuing solutions.

Unit	1	2	3	4	5	6	7	8
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CCP-A.4 Outline how iterative processes inform biomedical science decisions, improve solutions, and inspire new ideas.

Unit	1	2	3	4	5	6	7	8
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CCP-A.5 Evaluate the reliability and credibility of sources when gathering information.

Unit	1	2	3	4	5	6	7	8
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CCP-D Explain the value of diverse perspectives in the problem-solving process.

CCP-D.1 Explain how solutions for complex problems can require interdisciplinary collaboration to incorporate a wide range of perspectives and skills.

Unit	1	2	3	4	5	6	7	8
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CCP-E Explain why scientists must have the courage to take a calculated risk.

CCP-E.1 Explain the importance of risk taking in performing experiments and developing solutions.

Unit	1	2	3	4	5	6	7	8
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CCP-E.2 Identify the pros and cons associated with decisions made in biomedical science.

Unit	1	2	3	4	5	6	7	8
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CCP-E.3 Describe how failure, or unexpected results, can produce positive outcomes by improving understanding.

Unit	1	2	3	4	5	6	7	8
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CCP-E.4 Explain how creativity can lead to scientific discovery.

Unit	1	2	3	4	5	6	7	8
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CCP-F Create or improve a medical innovation using a design process.

CCP-F.1 Describe the impact of various medical innovations on human health.

Unit	1	2	3	4	5	6	7	8
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CCP-F.2 Discuss the process of inventing and improving medical innovations.

Unit	1	2	3	4	5	6	7	8
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Experimental Design (EXD):

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

EXD-A Design and carry out an experiment that investigates a research question.

EXD-A.1 Develop a testable hypothesis and design an experimental protocol that evaluates its validity.

Unit	1	2	3	4	5	6	7	8
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EXD-A.2 Distinguish between the independent and dependent variables.

Unit	1	2	3	4	5	6	7	8
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EXD-A.3 Identify and explain the purpose and importance of experimental controls.

Unit	1	2	3	4	5	6	7	8
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EXD-A.4 Maintain a detailed repeatable account of the experiment in a physical or digital laboratory notebook.

Unit	1	2	3	4	5	6	7	8
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EXD-A.5 Conduct background research using credible sources to identify and investigate a relevant research question.

Unit	1	2	3	4	5	6	7	8
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EXD-A.6 Select and use appropriate equipment to conduct experiments.

Unit	1	2	3	4	5	6	7	8
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EXD-A.7 Identify possible source of errors, then redesign and repeat the experiment when appropriate.

Unit	1	2	3	4	5	6	7	8
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EXD-A.8 Communicate the findings of an experiment in oral and written (including digital) form.

Unit	1	2	3	4	5	6	7	8
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EXD-A.9 Describe why experimental design is a continual process.

Unit	1	2	3	4	5	6	7	8
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EXD-A.10 Collaborate with a mentor who is an expert in their field.

Unit	1	2	3	4	5	6	7	8
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EXD-A.11 Build a model, prototype, or schematic of proposed designs.

Unit	1	2	3	4	5	6	7	8
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EXD-B Collect and analyze data to draw a conclusion.

EXD-B.1 Demonstrates an ability to accurately follow a lab protocol.

Unit	1	2	3	4	5	6	7	8
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EXD-B.2 Display data appropriately and accurately in multiple formats (graphs, tables, diagrams).

Unit	1	2	3	4	5	6	7	8
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EXD-B.3 Perform necessary data calculations.

Unit	1	2	3	4	5	6	7	8
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EXD-B.4 Draw logical conclusions from experimental data.

Unit	1	2	3	4	5	6	7	8
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Competencies, Domains, Objectives, Knowledge and Skills

Technical Knowledge and Skills

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

General Laboratory Practices (GLP):

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

GLP-A Select and use appropriate tools, technology, and/or software for experimental and clinical data collection and analysis.

GLP-A.1 Explain and conduct gel electrophoresis.

Unit	1	2	3	4	5	6	7	8
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GLP-A.2 Describe and demonstrate aseptic techniques for handling, culturing, and analyzing bacteria colonies.

Unit	1	2	3	4	5	6	7	8
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GLP-A.3 Analyze cell and tissue samples using appropriate microscopy skills.

Unit	1	2	3	4	5	6	7	8
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GLP-A.6 Select and use appropriate technology (probes and sensors) and software to collect and analyze physiological data.

Unit	1	2	3	4	5	6	7	8
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Efficient Systems (ESY):

Designing efficient hospitals can reduce patient wait time and save lives.

ESY-A Design a medical space that is conducive to patient wellness and improves patient outcomes.

ESY-A.1 Describe how medical innovations can reduce wait time in the emergency room.

Unit	1	2	3	4	5	6	7	8
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ESY-A.2 Design an efficient emergency room to reduce patient wait time.

Unit	1	2	3	4	5	6	7	8
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ESY-A.3 Determine how patient health issues are prioritized in an emergency room.

Unit	1	2	3	4	5	6	7	8
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Competencies, Domains, Objectives, Knowledge and Skills

Environmental Health and Safety (EHS):

Toxins and other environmental hazards can significantly affect human health.

EHS-A Evaluate the impact of environmental factors on human health.

EHS-A.1 Identify environmental concerns that are potentially harmful to health.

Unit	1	2	3	4	5	6	7	8
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EHS-A.2 Explain how various factors affect how individuals respond to a given toxin.

Unit	1	2	3	4	5	6	7	8
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EHS-A.3 Design and conduct water quality testing for the presence of contaminants.

Unit	1	2	3	4	5	6	7	8
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EHS-A.4 Create an environmental health profile and action plan for the local area.

Unit	1	2	3	4	5	6	7	8
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EHS-A.5 Create and analyze a dose response model for the exposure of toxic chemicals.

Unit	1	2	3	4	5	6	7	8
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Microbiology (MIB):

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

MIB-C Use proper techniques to identify strains of bacteria.

MIB-C.1 Conduct water quality testing for the presence of coliforms and E. coli.

Unit	1	2	3	4	5	6	7	8
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MIB-C.2 Analyze bacterial DNA using PCR and gel electrophoresis to identify the strains.

Unit	1	2	3	4	5	6	7	8
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Public Health (PHE):

Studying the cause and location of disease outbreaks assists researchers in protecting the public from epidemics.

PHE-A Analyze health and disease data to inform public health decisions.

PHE-A.1 Analyze medical evidence to diagnose a patient's health condition.

Unit	1	2	3	4	5	6	7	8
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PHE-A.2 Analyze data from epidemiological studies to investigate the symptoms, pathogen, and transmission pattern of a mystery illness.

Unit	1	2	3	4	5	6	7	8
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PHE-A.3 Identify medical interventions that can address global health issues.

Unit	1	2	3	4	5	6	7	8
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PHE-A.4 Calculate measures of risk used to demonstrate a possible association between a risk factor and a disease.

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PHE-A.5 Describe how to set up case-control and cohort studies.

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Statistics (STA):

Mathematics can assist a researcher in determining whether experimental data is statistically significant.

STA-A Use statistics to solve biomedical science problems.

STA-A.1 Conduct two sample t-tests to analyze data.

Unit	1	2	3	4	5	6	7	8
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STA-A.2 Explain how data can be manipulated in scientific studies.

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STA-A.3 Discuss how scientific data is presented in the media and in scientific journals.

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STA-A.4 Describe how statistics can be used inappropriately to manipulate data and/or mislead readers.

Unit	1	2	3	4	5	6	7	8
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