Project Lead The Way [PLTW] Medical Interventions

PEIMS Code: N1302094

Abbreviation: MEDINT

Grade Level(s): 9–12

Award of Credit: 1.0

Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

Course Description:

Medical Interventions (MI) allows students to investigate the variety of interventions involved in the prevention, diagnosis, and treatment of disease. Students explore how to prevent and fight infection; screen and evaluate the code in our DNA; prevent, diagnose, and treat cancer; and prevail when the organs of the body begin to fail. A wide range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics are explored in real-world, patient-centered scenarios. Interventions may range from simple diagnostic tests to treatment of complex diseases and disorders. Lifestyle choices and preventive measures are emphasized throughout the course as well as the role that scientific thinking and engineering design play in the development of interventions of the future. Students practice problem-solving with structured activities and progress to open-ended projects and problems that require them to develop planning, documentation, communication, and other professional skills.

Essential Knowledge and Skills:

(a) General Requirements. PLTW's Medical Interventions (MI) is recommended for students in grades 9-12. Recommended Prerequisites: At least one credit in a Level 2 or higher course in biomedical science. Students successfully completing the course shall earn one credit.

(b) Introduction.

(1) Medical Interventions (MI) allows students to investigate the variety of interventions involved in the prevention, diagnosis, and treatment of disease. Students explore how to prevent and fight infection; screen and evaluate the code in our DNA; prevent, diagnose, and treat cancer; and prevail when the organs of the body begin to fail. A wide range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics are explored in real-world, patient-centered scenarios. Interventions may range from simple diagnostic tests to treatment of complex diseases and disorders. Lifestyle choices and preventive measures are emphasized throughout the course as well as the role that scientific thinking and engineering

design play in the development of interventions of the future. Students practice problem-solving with structured activities and progress to open-ended projects and problems that require them to develop planning, documentation, communication, and other professional skills.

(2) Students are encouraged to participate in extended learning experiences, such as career and technical student organizations and other leadership or extracurricular organizations.

(3) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills.

(1) Career Awareness: The student explains the education and skills required for biomedical science professionals and describes the societal impact of biomedical science professionals. The student is expected to:

(A) identify and describe the different careers of professionals who research, diagnose, and treat medical conditions;

(B) describe the education requirements, salary ranges, professional licensure, skills, and responsibilities for biomedical science professionals;

(C) explain the importance of lifelong learning for biomedical science professionals;

(D) apply professional standards, as they relate to the habits and characteristics of a biomedical science professionals;

(E) describe the impact that biomedical science research and interventions have on society, including disease diagnosis, prevention, and treatment; and

(F) describe the global impact of biomedical science solutions.

(2) Professionalism and Ethics: The student applies professional standards as they relate to the personal traits of a biomedical science professional and evaluates ethical and moral issues related to various medical interventions. The student is expected to:

(A) demonstrate the importance of honesty, integrity, and accountability for biomedical professionals;

(B) describe the importance of privacy for all individuals;

(C) create and support an environment that fosters teamwork, emphasizes quality, and promotes learning;

(D) describe the importance of ethical considerations when making biomedical science decisions;

(E) use Federal policy guidelines to defend who should receive a donated organ in each situation;

(F) defend arguments as to whether further research for xenotransplantation and tissue engineering should be banned;

(G) defend an argument governing future gene editing research;

(H) describe the bioethical concerns and considerations related to the use of cochlear implant technology; and

(I) explain why clinical trials are regulated by strict guidelines.

(3) Communication: The student communicates effectively with a specific audience. The student is expected to:

(A) describe acceptable formats for writing assignments and professional presentations;

(B) modify communications to meet the needs of the audience and be appropriate to the situation;

(C) cite references for all reports in an accepted format; and

(D) use proper elements of written communication (spelling, grammar, and formatting).

(4) Collaboration: The student creates an effective team environment to promote successful goal attainment. The student is expected to:

(A) explain the importance of demonstrating respect for others' viewpoints;

(B) describe the importance of each team member's contribution to the project;

(C) identify basic conflict resolution strategies and employ those strategies as necessary and appropriate; and

(D) employ a peer review process to give effective and constructive feedback to meet given outcomes.

(5) Experimental Design: The student designs an experiment that investigates a research question and collects and analyzes data to draw conclusions. The student is expected to:

(A) develop an experimental protocol that includes a testable hypothesis;

(B) distinguish between the independent and dependent variables;

(C) identify and explain the purpose and importance of experimental controls;

(D) maintain a detailed repeatable account of an experiment in a physical or digital laboratory notebook;

(E) conduct background research using credible sources;

(F) select and use appropriate equipment to conduct experiments;

(G) identify possible sources of errors, and when appropriate, redesign and repeat the experiment;

(H) communicate the findings of an experiment in oral and written format, which can include digital forms;

(I) describe why experimental design is a continual process;

(J) read and follow established protocols and instructions;

(K) display data appropriately and accurately in multiple formats such as graphs, tables, and diagrams;

(L) perform necessary data calculations; and

(M) draw logical conclusions from experimental data.

(6) Critical and Analytical Thinking: The student solves a problem using analytical and critical thinking, explains the value of diverse perspectives in the problem-solving process, and explains how scientists use calculated risks to increase scientific knowledge. The student is expected to:

(A) devise and execute a plan to solve a problem;

(B) obtain and process credible information from various sources in medical and biomedical fields;

(C) describe how persistence is a key mindset when identifying problems and pursuing solutions;

(D) outline how different processes inform biomedical science decisions, improve solutions, and inspire innovative ideas;

(E) explain how solutions for complex problems can require interdisciplinary collaboration to incorporate a wide range of perspectives and skills;

(F) explain the importance of risk taking in performing experiments and developing solutions in biomedical science;

(G) identify the pros and cons associated with decisions made in biomedical science; and

(H) describe how failure or unexpected results can produce positive outcomes by improving understanding.

(7) Biomedical Tools and Technology: The student demonstrates understanding, selection, and proper use of tools, technology, and software for experimental and clinical data collection and analysis. The student is expected to:

(A) conduct both horizontal gel electrophoresis for DNA and vertical systems for proteins;

(B) describe and apply aseptic techniques for handling and culturing microbial samples;

(C) analyze cell and tissue samples using appropriate microscopy skills;

(D) describe the various laboratory methods that are used to manufacture vaccines;

(E) explain the applications of polymerase chain reaction technology as well as the role of each reagent in the process;

(F) select and use appropriate technology, including probes, sensors, and software, to collect and analyze physiological data;

(G) describe the skill, dexterity, and eye-hand coordination necessary to complete surgical techniques;

(H) explain how DNA microarrays are used to compare gene expression, including mRNA expression, between different tissue samples or sample groups;

(I) describe how microarray data can be used to evaluate cancer risks; and

(J) demonstrate proper usage of a microscope.

(8) Analysis of Medical Evidence: The student collects and analyzes medical information to evaluate the cause, prevention, and treatment of disease. The student is expected to:

(A) analyze connections between patients in an outbreak situation, determine appropriate tests to identify the pathogen, and determine the steps for treatment and containment;

(B) interpret concentration results of a quantitative antigen-based assay for various patients to infer a path of infection;

(C) explain the impact vaccines have had on disease occurrence;

(D) match an organ donor with a compatible recipient based on blood typing and human leukocyte antigen typing results;

(E) explain why controlled, randomized, double-blind studies are considered the gold standard for clinical trials;

(F) analyze patient symptoms and medical evidence to diagnose a fictional patient; and

(G) analyze disease data, design epidemiologic studies, and evaluate prevention and therapy for chronic and infectious diseases.

(9) Microbiology: The student explains the structure and function of bacterial cells and how antibiotics work to disrupt their growth. The student is expected to:

(A) describe the function of the major structures in the bacterial cell and how these structures provide cell defense;

(B) explain how the four main classes of antibiotics target specific bacterial structures and biological pathways;

(C) compare the three types of bacterial gene transfer and the relationship of this transfer to antibiotic resistance; and

(D) describe the ways in which the misuse of antibiotics can impact bacterial growth.

(10) Diagnostic Testing: The student describes how diagnostic tests are used to assess the health of an individual and indicate the presence of disease. The student is expected to:

(A) explain the principles of the Enzyme-linked Immunosorbent Assay (ELISA) test and interpret ELISA results to detect the presence and concentration of a pathogen;

(B) determine the appropriate hearing tests to diagnose sensorineural and conductive hearing loss;

(C) interpret audiograms to identify distinct types of hearing loss and select appropriate interventions;

(D) analyze the difference between normal cells and cancer cells; and

(E) describe the different uses for X-rays, bone scans, computed tomography scans, and Magnetic Resonance Imaging, as well as how each technology works.

(11) Disease Physiology: The student explains the physiological processes associated with disease or injury. The student is expected to:

(A) relate the structure of the ear to function and explain the pathophysiology of hearing loss;

(B) connect cell cycle regulatory gene mutations to the development of cancer;

(C) describe the behavioral, biological, environmental, and genetic risk factors that can increase the chance that a person will develop cancer;

(D) evaluate genetic risk factors for cancer using family history and marker analysis; and

(E) identify symptoms of End Stage Renal Disease (ESRD).

(12) Disease Prevention and Treatment: The student describes how medical interventions are used to improve health or alter the course of an illness. The student is expected to:

(A) explain how reproductive technology works;

(B) evaluate the promise and limitations of gene editing;

(C) evaluate the benefits and side effects of cancer treatments;

(D) describe how myoelectric prosthetic limbs work to restore function to patients who have lost a limb;

(E) differentiate between physical and occupational therapy;

(F) analyze the pros and cons of hemodialysis, peritoneal dialysis, and kidney transplant for a patient with ESRD;

(G) explain how biofeedback therapy can improve health and manage pain; and

(H) describe how vaccinations protect against illness.

(13) Disease Prevention and Treatment: The student describes the technology and lab applications of bioinformatics in health and wellness, explain how recombinant DNA technology allows scientists to custom-design bacteria that can produce a variety of important protein products. The student is expected to:

(A) describe how computer database technology can be used to analyze genetic information;

(B) use computer database technology to analyze genetic information and interpret the results;

(C) explain how molecular tools such as ligase and restriction enzymes are used to cut and paste DNA from various sources;

(D) identify which restriction enzyme to use for a given situation;

(E) outline the steps required to produce a protein in the laboratory;

(F) describe how recombinant DNA technology can be used to produce vaccines;

(G) insert plasmid DNA into bacterial cells in the laboratory and observe how this genetic information relates to new traits of the bacteria; and

(H) isolate a protein based on its properties using column chromatography and verify an isolated protein using protein electrophoresis.

(14) Disease Prevention and Treatment: The student describes the applications of bioinformatics in health and wellness, explains how single base pair changes, called single nucleotide polymorphisms (SNPs), can be identified through genetic testing and often correlate to specific diseases or traits, and describes 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. The student is expected to:

(A) identify single base-pair differences in DNA through laboratory techniques, such as DNA extraction, PCR, and restriction analysis;

(B) predict how a person will respond to medications based on patient SNP profile; and

(C) explain how SNPs can be identified through genetic testing and how they correlate to specific diseases or traits.

Recommended Resources and Materials:

American Psychological Association. 2020. “Academic Writer Tutorial: Basics of Seventh Edition APA Style.” https://extras.apa.org/apastyle/basics-7e/#/.

ACS Chemistry for Life. 2022. “Alexander Fleming Discovery and Development of Penicillin.” https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/flemingpenicillin.html.

National Human Genome Research Institute – National Institutes of Health.2006. "Reproductive genetic testing." http://www.genome.gov/10004766.

Directory of Open Access Journals. 2023. https://doaj.org/.

ProQuest. 2023. "Library Science Database." https://about.proquest.com/en/products-services/libraryscience.

Project Lead The Way Teacher and Student Resources. 2022. https://my.pltw.org/login.

Project Lead The Way Software and Technology Requirements. 2023. https://pltw.org/pltw-software.

Recommended Course Activities:

- Students explore interventions involved in detecting, fighting, and preventing an infectious disease as they investigate a potential outbreak at a fictitious college, explore how to diagnose and manage hearing loss, investigate the impact vaccination has had on public health over the years, and interpret how vaccines have altered disease trends.
- Students examine how the study of genetics alters the way doctors and scientists treat disease, as well as the way humans reproduce by researching types of genetic testing and screening available to potential parents and discuss ethical implications of these tests.
- Students examine available reproductive technology and debate and discuss medical interventions of the future.
- Through investigation of a fictitious patient file, students explore techniques used to diagnose cancer, including diagnostic imaging and examination of cancerous tissue, look at the physiology of cancer through pathology, and investigate the genes involved with cancer.
- Students design and perform an experiment to test the effectiveness of various sunscreens or types of cloth against UV light, using UV-sensitive yeast cells.
- Students perform marker analysis on mock DNA samples to diagnose a BRCA2 gene mutation associated with breast cancer, play the role of a virologist working with viruses associated with cancer, and create a timeline of routine cancer screenings we might complete in our lifetime.
- Students explore the future of cancer treatment as they review clinical trials and pharmaceutical innovation to design their own cancer treatment clinical trial.
- Students learn how to produce and purify a protein in a laboratory setting to understand how human insulin is produced to treat diabetics.
- Students work in teams to investigate a fictional patient's symptoms, suggest further diagnostic tests, and use the information they find to piece together a diagnosis and suggest the best treatment option. Acting as part of a surgical team, students follow the patient as they go through the process of organ transplantation and practice laparoscopic and general surgery techniques.
- Students use what they learn throughout the course to create a profile of the most optimal traits for resilience and health.

Suggested methods for evaluating student outcomes:

- performance assessments (example: Following Proper Protocols During Laboratory Experiments)

- clinical trial designs (example: Design of an immunotherapy or nanotechnology-based cancer treatment and a clinical trial to test the safety and efficacy of their treatment)
- student self-reflections
- lab reports and laboratory notebook checks
- creation of a family tree for a fictional family based on 'Family Bulletins' provided in each unit
- live presentations
- case study diagnoses
- calculations
- online interim assessments (by topic)
- online end-of-course assessment

Teacher qualifications:

- Vocational Health Science Technology
- Secondary Biology (Grades 6-12)
- Secondary Science, Composite (Grades 6-12)
- Secondary Science (Grades 6-12)
- Life Science: Grades 7-12
- Life Science: Grades 8-12
- Health Science: Grades 6-12
- Legacy Master Science Teacher
- Mathematics/Physical Science/Engineering: Grades 6-12
- Mathematics/Physical Science/Engineering: Grades 8-12
- Science, Technology, Engineering, and Mathematics: Grades 6-12
- Science: Grades 7-12•Science: Grades 8-12
- Chemistry: Grades 7-12
- Chemistry: Grades 8-12
- Secondary Chemistry (Grades 6-12)
- Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.
- Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.
- Vocational Trades and Industry. This assignment requires appropriate work approval.
- Vocational Health Occupations.

Additional information:

PLTW's Core Training for Medical Interventions requires approximately 90 hours of instruction led by PLTW approved Master Teachers (80 hours of class time plus 10 hours of prerequisite work). It is offered year-round with multiple options to allow teachers to select dates and pacing of their training session. Course mastery is demonstrated by the submission and approval of a course portfolio that meet's PLTW's requirements. After successful completion of Core Training, teachers receive access to the National PLTW Biomedical Science Professional Learning Community, course-specific student and classroom instructional resources, and Ongoing Training resources through the PLTW Content Management System.

Current details, such as pricing and listings for all PLTW professional development, can be found at https://www.pltw.org/our-programs/professional-development/core-training. At the time of this application submission, the course cost was* $2,400.

Note: PLTW offers a training guarantee to schools. The PLTW Training Guarantee protects a district's investment in PLTW programs by guaranteeing if a teacher leaves within four years of earning a PLTW credential, PLTW will provide a grant in the amount of the training fee for the district to train a teacher in the same course, replace the credential(s), and support continued student learning.

* PLTW Professional Development Fees are subject to change annually. Changes are communicated via email from PLTW Communications and on the PLTW website at least 90 days prior to the effective date for the upcoming school year. There are no changes for the 2023-24 school year.

Please contact Project Lead The Way directly with questions.
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