Project Lead The Way [PLTW] Human Body Systems

PEIMS Code: N1302093

Abbreviation: HUMBODSY

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:

In the Human Body Systems (HBS) course, students examine the interactions of body systems as they explore identity, communication, power, movement, protection, and homeostasis. Students design experiments to investigate the structures and functions of the human body and use data acquisition software to monitor body functions such as muscle movement, reflex and voluntary actions, and respiration. Exploring science in action, students build organs and tissues on a skeletal manikin, work through interesting real-world cases, and often play the role of biomedical professionals to solve medical mysteries. 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 Human Body Systems (HBS) course is recommended for students in grades 9th – 12th. There are no prerequisite courses required for enrollment in HBS. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) In the Human Body Systems (HBS) course, students examine the interactions of body systems as they explore identity, communication, power, movement, protection, and homeostasis. Students design experiments, investigate the structures and functions of the human body and use data acquisition software to monitor body functions such as muscle movement, reflex and voluntary action, and respiration.

(2) Exploring science in action, students build organs and tissues on a skeletal manikin, work through interesting real-world cases, and often play the role of biomedical professionals to solve medical mysteries.

(3) 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.

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

(5) 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 of biomedical science professionals;

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

(D) demonstrate and explain the importance of punctuality and meeting deadlines; and

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

(2) Professionalism and Ethics: The student applies professional standards, as they relate to the personal traits of a biomedical science professional. The student is expected to:

(A) demonstrate and explain 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; and

(E) create a professional resume or portfolio for a specified career.

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

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

(4) Collaboration: The student identifies and applies strategies of an effective team environment to promote successful goal attainment: The student is expected to:

(A) explain the importance of demonstrating respect of 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 collaboratively designs and carries out an experiment that investigates a research question and collects and analyzes data to draw a conclusion. 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 and repeatable account of the 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 source of errors, then redesign and repeat the experiment when appropriate;

(H) communicate the findings of the experiment in oral, written, and digital forms by displaying data appropriately and accurately in formats including graphs, tables, and diagrams;

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

(J) collect and analyze data to draw a conclusion;

(K) read and follow established protocols and instructions;

(L) determine and perform necessary data calculations; and

(M) communicate logical conclusions from experimental data.

(6) Critical and Analytical Thinking: The student solves an open-ended 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) solve a problem using analytical and critical thinking skills;

(B) create and execute a plan to solve a problem, including using experimental design to investigate how a specific environmental factor influences enzyme function;

(C) explain the importance of collecting data from multiple sources to solve a problem;

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

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

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

(G) explain the importance of risk taking in performing experiments and developing solutions;

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

(I) describe how failure, or unexpected results, can produce positive outcomes by improving understanding; and

(J) explain how creativity can lead to scientific discovery.

(7) Biomedical Tools and Technology: The student selects and uses appropriate tools, technology, and software for experimental and clinical data collection and analysis. The student is expected to:

(A) demonstrate proper usage of a microscope viewing cell and tissue samples;

(B) explain the steps to conduct gel electrophoresis;

(C) use appropriate tools, such as micropipettes, calipers, and probes, to measure substances and body characteristics; and

(D) use appropriate technology, including probes and sensors with the software to collect and analyze physiological data.

(8) Analysis of Medical Evidence: The student uses and analyzes medical evidence to draw a conclusion. The student is expected to:

(A) analyze medical evidence and draw a conclusion;

(B) review medical evidence to diagnose a patient and recommend a course of treatment;

(C) describe how features of bones contribute to a person's unique physical identity;

(D) describe the relationship between the length of long bones and the overall height of an individual;

(E) explain how pharmaceuticals interact with body systems;

(F) analyze a patient’s metabolic needs, Basal Metabolic Rate, and Body Mass Index to make appropriate recommendations to improve their health;

(G) demonstrate correct use of directional and regional terms to describe location in the human body; and

(H) analyze medical data to diagnose lung disorders and design a corresponding treatment plan.

(9) Analysis of Disease: The student describes how imbalances in the body system can result in diseases. The student is expected to:

(A) explain how events can cause organ system dysfunction and lead to disease;

(B) describe and evaluate medical intervention strategies that can treat or cure diseases;

(C) explain how lifestyle choices can lead to disease;

(D) analyze physical symptoms of a patient and relate these symptoms to errors in hormonal levels;

(E) analyze how structural dysfunction of blood vessels impacts overall health; and

(F) interpret how a breakdown in communication in the central nervous system impacts the function of the human body.

(10) Structure and Function: The student explains how body systems work together to maintain homeostasis, describe the structure and function of organ systems that are used for communication. The student is expected to:

(A) describe the structure and function of the four types of human tissues;

(B) explain how the body systems respond to extreme conditions and maintain homeostasis;

(C) describe negative feedback loops to demonstrate homeostasis;

(D) model the structures and describe the functions of the nervous and endocrine systems and sensory organs such as the eye;

(E) describe the various forms of communication that help the human body interact with the environment, such as processing and responding to sensory information;

(F) compare and contrast chemical and electrical modes of communication and match regions of the brain with their primary function in the human body;

(G) describe how the movement of ions across the cell membrane of a neuron generates an action potential and propagates electrical signals;

(H) outline what happens in the human body from an initial stimulus to a response in both voluntary and involuntary actions; and

(I) explain how the body uses feedback mechanisms to maintain proper levels of hormones for homeostasis.

(11) Structure and Function: The student describes the structure and function of organ systems that provide power. The student is expected to:

(A) explain how light is processed differently in a person with normal vision versus a person with myopia or hyperopia;

(B) describe how the digestive, respiratory, and urinary systems work together to power the body;

(C) model the structure and describe the function of the organs in the digestive, respiratory, and urinary systems;

(D) explain how enzymes act on a particular substrate and how their reactions are affected by factors such as temperature and pressure;

(E) explain how the function of the lungs facilitates the exchange of oxygen and carbon dioxide between air and the body; and

(F) describe the connections between urine and blood and the exchange of ions and fluids that occurs across the nephron.

(12) Structure and Function: The student describes the structure and function of organ systems that provide movement and describes the structure and function of organ systems that provide protection for the human body. The student is expected to:

(A) explain how the roles of macromolecules, oxygen, and water enable the body systems to power the body;

(B) model the structure and describe the function of the circulatory, respiratory, and muscular systems;

(C) demonstrate or identify types of movement of various joints;

(D) interpret muscle function based on muscle attachment to bone;

(E) explain the mechanisms of muscle contractions and describe how the body responds to exercise;

(F) model the structure and describe the function of the skeletal, integumentary, lymphatic, immune, and nervous systems;

(G) explain the impact of burns on the skin's structure and protective ability;

(H) explain the process of skeletal repair and the types of bone fractures;

(I) explain the action of antibodies in response to antigens and describe how vaccinations protect against illness;

(J) summarize the role of cell surface molecules in determining capability for blood transfusions; and

(K) explain the role of osteoblasts and osteoclasts in bone production and calcium balance in the body.

(13) Molecular Biology: The student describes the process of analyzing DNA. The student is expected to:

(A) explain the structure and function of DNA;

(B) explain the action and use of restriction enzymes;

(C) describe how gel electrophoresis can be used to examine DNA differences between individuals; and

(D) analyze gel electrophoresis data.

(14) Clinical Testing: The student explains clinical tests that are used to diagnose malfunctioning organ systems. The student is expected to:

(A) describe how clinical diagnostic exams are conducted to determine the health of a body system;

(B) complete and analyze blood test results to determine blood transfusion compatibility;

(C) describe medical interventions that improve human health;

(D) evaluate visual perception by testing depth perception, peripheral vision, color vision, and visual acuity;

(E) analyze spirometry data to determine tidal volume, vital capacity, and minute volume;

(F) analyze urinalysis results to diagnose disease and dysfunction in human body systems;

(G) measure range of motion with a goniometer;

(H) measure peripheral pulses using Doppler ultrasound and calculate an ankle brachial index (ABI);

(I) interpret Electromyography data to assess muscle fatigue;

(J) interpret X-rays to determine specific types of bone fractures; and

(K) interpret coding for prescriptions to understand terminology for pharmacology.

Recommended Resources and Materials:

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

Evans, C. (1996). "The Casebook of Forensic Detection: How Science Solved 100 of the World's Most Baffling Crimes." John Wiley and Sons, Inc.

Crime Scene. 2023. "Crime Scene: Previous Cases." https://www.crimescene.com/previous

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 will work with a two-foot skeletal model and use clay to build various organs, tissues, and vessels on the skeletal frame.
- Students play the role of forensic anthropologists to examine skeletal remains and analyze four bones to estimate as much as possible about the person's sex, ancestry, age, and height.
- Using simulated DNA samples collected from the bones of the skeleton, students use molecular techniques to determine identity.
- Students investigate the mechanisms of hormone action and the regulatory power of feedback as they investigate a medical mystery.
- Students design and build models of the human digestive system and track chemical digestion of a bite of food as it moves through the digestive system model. Acting as nutritionists or dieticians, students then meet a fictional client, analyze their diet, and write a client report that proposes changes to improve overall health.
- Students explore the mechanics of breathing and use a spirometer to evaluate lung function.
- Students unlock the medical clues hidden in urine as they complete urinalysis testing for fictional patients.
- Students measure a joint's range of motion and visualize the role of connective tissue, such as cartilage, tendons, and ligaments, in cushioning and facilitating motion.
- Students combine information about power and movement to describe how the body fuels and responds to exercise to design a training plan for an athlete. Playing the role of a biomedical professional in a medical practice that caters to athletes, students design a plan that looks at all aspects of training, from diet and exercise to hydration and injury prevention.
- Students explore how the body deals with extreme external environments and how it reacts to and defends against injury and illness to discuss and design medical interventions.

Suggested methods for evaluating student outcomes:

A sample of assessment types include:

- Performance Assessments (example: Building of an 'Anatomy in Clay Manikin' to demonstrate the meaning of various directional and regional terms)
- Student Self Reflections
- Lab Reports
- Live Presentations (with Presentation Rubrics)
- Case Study Diagnoses
- Accuracy of Calculations
- Checklists
- Online Interim Assessments (by topic)
- Online End-of-Course Assessment

Teacher qualifications:

- Health Science: Grades 6-12.
- Health Science Technology Education: Grades 8-12.
- Vocational Health Occupations.
- 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
- 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.

Additional information:

Successful completion of the Project Lead The Way's Core Training for Human Body Systems is required.

PLTW Core Training:

PLTW's Core Training for Human Body Systems 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: Currently, 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 for questions about program requirements:
Project Lead The Way
Solution Center
Toll Free: 877.335.PLTW (7589) solutioncenter@pltw.org