PLTW Biomedical Science
Principles of Biomedical Science | Course Outline

Analyze the evidence found at a crime scene and help the medical examiner uncover clues left on a body to solve a mystery. Question, diagnose, and propose treatment and care for patients in a family medical practice. Track down the source of a mysterious outbreak at a local hospital. Access and stabilize a patient during an emergency and prepare for medical surge and mobile medical care. Collaborate with professionals in other fields to innovate and design solutions to local and global medical problems.

Whether seeking a career in medicine or healthcare or simply looking to for the challenge of real-world problems, students in Principles of Biomedical Science will practice how to think creatively and critically to innovate in science and will gain practical experience with experimental design and the design process.

Principles of Biomedical Science (PBS) is a full-year high school course in the PLTW Biomedical Science Program. This course serves to provide foundational knowledge and skills in fields such as biology, anatomy & physiology, genetics, microbiology, and epidemiology as well as engage students in how this content can be applied to real-world situations, cases, and problems.

Through both individual and collaborative team activities, projects, and problems, students will tackle real-world challenges faced by biomedical professionals in the field. They will work with the same tools and equipment used in hospitals and labs as they engage in relevant hands-on work. Students will develop skill in technical documentation to represent and communicate experimental findings and solutions to problems. In addition, students will explore how connections to other disciplines such as computer science and engineering shape the future of medicine and practice collaboration techniques that will help them connect with professionals across any field.

Following is a summary of the units of study included in the course for the 2020-2021 academic year. Alignment with NGSS, Common Core, National Consortium for Health Science Education, and other standards will be available through the PLTW Alignment web- based tool. Activities, projects, and problems are provided to the teacher through an online delivery system, PLTW Courses.

The course requires a rigorous pace, and it is likely to contain more material than a skilled teacher new to the course will be able to complete in the first iteration. Building enthusiasm for and a real understanding of the role, impact, and practice of biomedical scientists is a primary goal of the course.

PBS Unit Summary

Unit 1 Medical Investigation
Unit 2 Clinical Care
Unit 3 Outbreaks & Emergencies
Unit 4 Innovation, Inc.

Unit 1: Medical Investigation

In Unit 1 students engage in forensic science and medical examination investigations in order to: a.) explore biological and forensic science careers; b.) gain experience in experimental design and data analysis; c.) learn about biomolecules and their role in determining identity; d.) learn about human anatomy and physiology and causes of death; e.) practice synthesizing multiple forms of data to draw conclusions; and f.) work to develop professional communication skills.

Medical Investigation

Lesson 1.1	Investigating the Scene
Lesson 1.2	Master the Morgue
Lesson 1.3	Open Investigation

Lesson 1.1 Investigating the Scene

In lesson 1.1, students begin their training as medical investigators. Shadowing members of the forensic investigation team, they will document and analyze the clues left at the scene of a woman's death. A video from the police commissioner emphasizes the severity of the situation, the need for more qualified professionals to help solve these types of cases, and the need for them to get to the bottom of the case ASAP. Students will sketch the crime scene and document evidence, analyze trace evidence in the lab, analyze biometric data of interviewed suspects, as well as record a video check-in for the police commissioner – chronicling what they have learned about the case in this lesson. Students will also be introduced to experimental design as well as proper scientific documentation.

Lesson 1.2 Master the Morgue

In lesson 1.2, students shadow the medical examiner to investigate what clues the body provides about the cause and manner of death. Students explore human body system structure and function as they investigate the composition of an autopsy. They will explore the many pieces of evidence that go into determining time of death and complete toxicology testing to determine the presence of drugs or chemicals in the body of the decedent. Examining basic tissue types in the body, students will zoom in to the microscopic level for clues that can't be seen with the naked eye. Students will then explore gross anatomy as they complete an "autopsy" dissection of a preserved heart. Using what they have learned in this lesson and from the examination of evidence from the scene, students will determine the cause, mechanism, and manner of death of the decedent.

Lesson 1.3 Open Investigation

Now that students have "graduated" from their training, they will be tasked to solve a new case. They will explore a virtual crime scene, gather evidence from the scene and persons of interest, complete laboratory testing, analyze evidence to deduce what happened, and complete an autopsy report using test and examination results. In preparation for court testimony, they must create an evidence board that illustrates the case to a judge or jury.

Unit 2: Clinical Care

Students assume the role of different medical professionals working through the schedule of patients in a family care clinic in order to: a.) explore medical careers; b.) practice professional communication; c.) gain experience collecting, recording, and interpreting physiological data; d.) learn how to perform routine medical tests and evaluate results; e.) learn about cutting edge technologies revolutionizing healthcare; f.) understand the interconnectedness between body systems; and g.) explore the various causations and inheritance of disease.

Clinical Care

Lesson 2.1	Talk to Your Doc
Lesson 2.2	Decoding a Diagnosis
Lesson 2.3	New to the Practice

Lesson 2.1 Talk to Your Doc

Students begin their day at the PLTW Total Care Clinic. Each patient they see will highlight key clinical skills as well as allow students to explore biological and physiological content. Students will explore effective questioning techniques, learn about documentation of patient data and medical history in electronic medical records, and investigate issues related to patient privacy. They will collect and analyze vital signs from a patient, investigating how each vital sign relates to the overall health and homeostasis of the body as well as how these vital signs can be used as part of clinical care and disease diagnosis. Students will interpret the results of routine bloodwork and make recommendations on ways to improve overall health and limit disease risk. Students are also introduced to telehealth, wearable devices, and remote monitoring as they simulate a virtual visit with a diabetic patient. At the end of the lesson, students will apply what they have learned to design a plan for a routine visit of a patient with a chronic health condition.

Lesson 2.2 Decoding a Diagnosis

In this lesson students explore the relationship between DNA, chromosomes, genes and proteins as they work through the diagnosis of various patients in the practice. Students investigate the process of protein synthesis as they piece together how mutations are related to various health conditions. Students will also explore how abnormalities with chromosomes can contribute to disease and overall health. At the end of the lesson, students will use what they have learned to help a family interested in learning more about their genetic risk.

Lesson 2.3 New to the Practice

In the problem students are tasked with helping a new patient at the PLTW Total Care Clinic. They will need to evaluate all medical evidence, question the family, record vital signs, order and evaluate bloodwork and synthesize data to make a diagnosis.

Unit 3: Outbreaks & Emergencies

Working as public health officials and then as emergency responders, students are presented with a series of events they must address while exploring: a.) careers in public health, epidemiology, microbiology and emergency medicine; b.) professional communication and presentation; c.) data analysis; d.) processes by which critical medical decisions are made and acted upon; e.) processes by which patients are diagnosed with a contagious disease and by which a causative agent is identified.

Outbreaks & Emergencies

Lesson 3.1	Nonsocomial Nightmare
Lesson 3.2	Emergency Response
Lesson 3.3	Information Sharing

Lesson 3.1 Nonsocomial Nightmare

In this lesson students are part of the PLTW Disease Defense Team and they have been called to the local hospital. There have been a number of hospital acquired infections and the patients are not related or in the same ward. Students are challenged to investigate the case, determine why and how patients are getting sick and design a strategy for resolving the outbreak (and preventing another one). Through their investigation, students will investigate the chain of infection, agents of disease, as well as basic structure and function of the human immune system. In the lab, students will work to identify the infectious agent that plagues the fictional hospital.

Lesson 3.2 Emergency Response

Students will now serve as part of an emergency medical response team, trained to respond when access to care is limited during accidents, natural disasters, and other mass casualty events. As they respond to an emergency in the field, students will investigate assessment and stabilization of a patient, drug delivery and metabolism, techniques to stop bleeding, and communication between medical care providers. Students will evaluate hospital protocol for medical surge during an event as well as design a mobile response facility to assist with patient triage and care.

Lesson 3.3 Information Sharing

Students will apply what they have learned in the unit as they plan the design of an app to be used to trace outbreaks, respond to emergencies (local or global), increase response efficiency in emergencies, or provide another public health function. This app can be used by medical professionals or can be designed to be used by civilians in an emergency. Students will create mock-ups of their app, modeling the interactivity and peer review each other's designs.

Unit 4: Innovation, Inc.

Welcome to PLTW Innovation, Inc. – an incubator for innovation where some of the best minds in science and engineering endeavor to solve some of the world's most pressing biomedical challenges. Students tour Innovation, Inc. labs and engage in experiences designed to: a.) build their engineering and experimental design process skills, b.) challenge them to design solutions to current and emerging issues both on and off this world, c.) tangibly highlight that solutions to biomedical science problems rely on collaboration between professions, d.) build their computer science skills by using computer aided design (CAD) and geographic information system (GIS) to innovate the future of medicine, and e.) explore career fields on the forefront of medicine.

Innovation, Inc.

Lesson 4.1	Designing the Future
Lesson 4.2	New Frontier
Lesson 4.3	Invitation to Innovation

Lesson 4.1 Designing the Future

In lesson 4.1 students will tour labs in the company, each dedicated to a different area of research, innovation, and design. They will investigate innovation in medical device development as they design model vessels for testing of cardiac stents. They will explore how computer-aided design (CAD) can be used for modeling and prototyping in innovation. Students will explore innovation in drug delivery as they design and test the formulation for a new drug. Focusing on large scale efforts in disease prevention and health promotions, they will then design a comprehensive initiative that could be implemented in communities around the country.

Lesson 4.2 New Frontier

In this lesson students expand their exploration of innovation to new frontiers. They will explore how the body reacts to travel to and life in space and design innovative improvements. They will then dive under the sea as they locate and test marine organisms for bioactive compounds useful as therapeutics. In the project students will be tasked with identifying the next frontier for scientific exploration using GIS and designing an innovation for use in exploring, existing in, or adapting materials from, this new frontier. Students will summarize their research and present their proposal in an interactive story map.

Lesson 4.3 Invitation to Innovation

In the problem, students are tasked with competing for open lab space at PLTW Innovation, Inc. To make their case, students apply all they have learned in this unit (and course) to design a medical innovation.

The information included in this document is subject to change. As with all course materials, we will continue to update as more information becomes available.