



### **Goal:**

To provide advanced science, technology, engineering and math (STEM) curriculum for students at Freedom and Liberty high schools and engage a network of community leaders, university affiliates and local industries in STEM partnerships.

### **Overview:**

The Bethlehem Area School District's *Roadmap to Educational Excellence* provides a framework for 13,500 students incorporating four key focus areas (core learning, stretch learning, student engagement, personal skill development) and specific performance goals for each school and student. To support stretch learning as well as the needs of the local and national economy, the Bethlehem Area School District has implemented Project Lead the Way (PLTW), an internationally-renown program, that includes hands-on, project based engineering and biomedical science courses that engage students on multiple levels. PLTW exposes students to areas of study that they currently do not have an opportunity to pursue, and provides them with a foundation and proven pathway to college and career success.

### **Characteristics:**

Project Lead the Way is the leading provider of rigorous and innovative Science, Technology, Engineering, and Mathematics (STEM) education curricular programs used in elementary, middle, and high schools across the U.S.

STEM education is at the heart of today's high-tech, high-skill global economy. For America to remain economically competitive, our next generation of leaders – the students of today – must develop the critical-reasoning and problem-solving skills that will help make them the most productive in the world.

STEM education programs like the one offered by PLTW engage students in activities, projects, and problem-based learning, which provides hands-on classroom experiences. Students create, design, build, discover, collaborate and solve problems while applying what they learn in math and science. They are also exposed to STEM fields through professionals from local industries who supplement the real-world aspect of the curriculum through mentorships and workplace experiences.

Project Lead the Way's comprehensive curriculum for engineering and biomedical sciences has been collaboratively designed by PLTW teachers, university educators, engineering and biomedical professionals and school administrators to promote critical thinking, creativity, innovation and real-world problem solving skills in students.

The hands-on, project-based engineering courses for high schools and biomedical sciences courses engage students on multiple levels, expose them to areas of study that they typically do not pursue, and provide them with a foundation and proven path to college and career success.

## **Outcomes:**

Over the last several years, numerous academic institutions have released reports highlighting Project Lead The Way's success in engaging the hearts and minds of students through STEM education. Among other things, the reports find that Project Lead the Way (PLTW) students are outperforming their peers in school and that they are more focused on attending college than non-PLTW students. The studies are all unique in how they were conducted - some of them cover PLTW programs in certain regions, some in specific school districts, while others take a look at how PLTW alumni are performing in college. Every report is different, yet the results say the same thing: PLTW is preparing students for the global economy.

To help prepare all students for the global workforce, the College Board and Project Lead the Way have partnered to encourage student participation in science, technology, engineering, and math (STEM) courses and build their interest in STEM degrees and careers. The program leverages the success of the College Board's Advanced Placement Program and Project Lead the Way's applied learning program. Students who complete the requirements of their chosen pathway earn the Advanced Placement and Project Lead the Way student recognition, a qualification that demonstrates to colleges and employers that the student is ready for advanced course work and interested in STEM related careers.

## **Courses:**

**The PLTW Pathway To Engineering Program** is a sequence of courses that follows a proven hands-on, real-world problem-solving approach to learning. Throughout this program, students learn and apply the design process, acquire strong teamwork and communication proficiency, and develop organizational, critical-thinking, and problem-solving skills. They discover the answers to questions like how are things made and what processes go into creating products? Students use the same industry-leading 3D design software used by companies like Intel and Lockheed Martin. They explore aerodynamics, astronautics, and space life sciences. Students apply biological and engineering concepts related to biomechanics - think robotics. They design, test, and actually construct circuits and devices such as smart phones and tablets and work collaboratively on a culminating capstone project. This program is STEM education, and it is at the heart of today's high-tech, high-skill global economy.

During the first year of implementation, schools are required to offer at least one of the foundation courses and ultimately implement both foundation courses and one or more of the five specialization courses and/or capstone course.

Principles of Engineering courses complement traditional mathematics and science courses and can serve as the foundation for STEM-centered or specialized academies. The program is designed to prepare students to pursue a post-secondary education and careers in STEM-related fields.

### ***Courses***

- **Introduction to Engineering Design**
  - Designed for 9th or 10th grade students, the major focus of Introduction to Engineering Design is the design process and its application. Through hands-on projects, students apply engineering standards and document their work. Students use industry standard 3D modeling software to help them design

solutions to solve proposed problems, document their work using an engineer's notebook, and communicate solutions to peers and members of the professional community.

- **Principles of Engineering**
  - Designed for 10th or 11th grade students, this survey course exposes students to major concepts they'll encounter in a post-secondary engineering course of study. topics include mechanisms, energy, statics, materials, and kinematics. They develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges, document their work and communicate solutions.
- **Environmental Sustainability (offered at Freedom High School)**
  - In Environmental Sustainability, students investigate and design solutions in response to real-world challenges related to clean and abundant drinking water, food supply, and renewable energy. Applying their knowledge through hands-on activities and simulations, students research and design potential solutions to these true-to-life challenges.
- **Civil Engineering and Architecture (offered at Liberty High School)**
  - Students learn important aspects of building and site design and development. They apply math, science, and standard engineering practices to design both residential and commercial projects and document their work using 3-D architectural design software.
- **Engineering Design and Development**
  - In this capstone course, students work in teams to design and develop an original solution to a valid open-ended technical problem by applying the engineering design process. Students perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams design, build, and test their solutions while working closely with industry professionals who provide mentoring opportunities. Finally, student teams present and defend their original solution to an outside panel. This course is appropriate for 12th grade students.

**The Project Lead the Way Biomedical Sciences Program** is a sequence of courses, all aligned with appropriate national learning standards, which follows a proven hands-on, real-world problem-solving approach to learning. Students explore the concepts of human medicine and are introduced to topics such as physiology, genetics, microbiology and public health. Through activities, like dissecting a heart, students examine the processes, structures and interactions of the human body – often playing the role of biomedical professionals. They also explore the prevention, diagnosis and treatment of disease, working collaboratively to investigate and design innovative solutions to the health challenges of the 21st century such as fighting cancer with nanotechnology.

Throughout this program, students acquire strong teamwork and communication practices, and develop organizational, critical-thinking, and problem-solving skills. Along the way students investigate a variety of careers in biomedical sciences. During the first year of implementation, schools are required to offer at least one of the foundation courses and ultimately implement all

three foundation courses. The capstone course is optional.

Project Lead the Way Biomedical Science courses complement traditional science courses and can serve as the foundation for STEM- centered or specialized academies. The program is designed to prepare students to pursue a post- secondary education and careers in the biomedical sciences.

### *Courses*

- **Principles of the Biomedical Sciences**
  - Students investigate various health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. They determine the factors that led to the death of a fictional person, and investigate lifestyle choices and medical treatments that might have prolonged the person's life. The activities and projects introduce students to human physiology, medicine, and research processes. This course provides an overview of all the courses in the Biomedical Sciences program and lay the scientific foundation for subsequent courses. This course is designed for 9th or 10th grade students.
- **Human Body Systems**
  - Students examine the interactions of human body systems as they explore identity, 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. Exploring science in action, students build organs and tissues on a skeletal mannequin, work through interesting real world cases and often play the roles of biomedical professionals to solve medical mysteries. This course is designed for 10th, 11th or 12th grade students.
- **Medical Interventions**
  - Students investigate a variety of interventions involved in the prevention, diagnosis and treatment of disease as they follow the life of a fictitious family. Students explore how to prevent and fight infection; screen and evaluate the code in human DNA; prevent diagnose and treat cancer; and prevail when the organs of the body begin to fail. Through these scenarios, students are exposed to a range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics. This course is designed for 11<sup>th</sup> or 12th grade students.
- **Biomedical Innovation**
  - Students design innovative solutions for the health challenges of the 21st century. They work through progressively challenging open-ended problems, addressing topics such as clinical medicine, physiology, biomedical engineering, and public health. They have the opportunity to work on an independent project with a mentor or advisor from a university, hospital, research institution, or the biomedical industry. Throughout the course, students are expected to present their work to an audience of STEM professionals. This course is designed for 12<sup>th</sup> grade students.