



BIOMEDICAL SCIENCES
Getting Started



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OVERVIEW



SUMMARY & MISSION

PLTW is a national nonprofit organization that partners with middle schools and high schools to implement a curriculum, developed by it and imparted by teachers whom it has trained, that emphasizes hands-on experiences in Science, Technology, Engineering, and Mathematics (STEM) in an effort to prepare students for academic and professional success in these disciplines. PLTW aims to encourage an increasingly more diverse group of students to consider careers as scientists, technology experts, engineers, mathematicians, healthcare providers, and researchers in an effort to enable the United States to compete favorably in the global economy.

HISTORY & SCOPE

PLTW began in 1998 in 12 high schools in upstate New York as a program designed to address the shortage of engineering students at the college level. It has grown to a network of more than 3,300 middle and high schools in 50 states and the District of Columbia. In 2007, PLTW added a Biomedical Sciences program, also project-based, to stem an impending shortage of healthcare professionals and researchers.

CURRICULUM

PLTW's approach — using activities-, project-, and problem-based learning (or APPB learning) — centers on hands-on projects that have real-world applications. The curriculum makes mathematics and science relevant and strives to help students understand how the skills they are learning in the classroom may be applied in everyday life.

THREE TRACKS

PLTW Gateway To Technology (GTT) is a middle school program offered in six independent, nine-week units and designed to help students explore math, science, and technology. This activity-oriented program challenges and engages the natural curiosity of middle school students and is taught in conjunction with a rigorous academic curriculum.

PLTW Pathway To Engineering (PTE) is a four-year high school sequence taught in conjunction with traditional mathematics and science courses. PTE's eight courses, including Digital Electronics and Civil Engineering and Architecture, provide students with in-depth, hands-on knowledge of engineering and technology-based careers.

PLTW Biomedical Sciences Program (BMS) introduces high school students to the human body, cell biology, genetics, disease, and other biomedical topics in a sequence of four courses. The program prepares students for postsecondary education and training necessary for success in a wide variety of positions: physician, nurse, pharmaceutical researcher, technician, etc.

PLTW NETWORK

Teachers and guidance counselors at schools that offer PLTW courses may access a nationwide support network comprised of PLTW staff, master teachers, affiliate directors and state leaders who are Department of Education employees. PLTW has 36 affiliated colleges and universities that provide teacher training. They also offer college credits for some of the courses. Business partners offer grants and internships.

TALKING POINTS



A SHORTAGE OF HEALTHCARE WORKERS

The U.S. Department of Labor predicts that 8 of the 20 careers with the highest demand for employees in the next decade will be in the healthcare sector. The health services sector is projected to grow more than any other industry (about 30%) through 2014. The combination of an aging population, longer life expectancies, and rapidly advancing technology has created a growing demand for highly skilled professionals in a broad spectrum of healthcare and science careers.

A CHANGING ECONOMY

Postsecondary education and training have become an essential requirement for a steadily increasing percentage of jobs. Two-thirds of America's economic growth in the 1990s resulted from the introduction of new technologies.

HIGH SCHOOL REFORM

Nationally, of 100 ninth graders, only 68 will graduate from high school on time, 38 will directly enter college, 26 are still enrolled in their sophomore year of college, and only 18 graduate from college. The rates for minority students are even lower. Only one-third of America's workforce has a postsecondary education, yet 60% of new jobs in the 21st century require it.

MATHEMATICS, SCIENCE, & PROBLEM SOLVING

According to the latest results from the Program for International Student Assessment, America's 15-year-olds performed below the international average in mathematics literacy and problem solving, placing 27th out of 39 countries.

PLTW'S MISSION

PLTW's mission is to ensure that the United States succeeds in the increasingly high-tech and high-skill global economy by partnering with middle schools and high schools to prepare students to become the most innovative and productive in the world.

STUDENT ENGAGEMENT

PLTW is able to accomplish this mission because it has broken the code on student engagement through hands-on, project-based curriculum in STEM fields. To date, more than 500,000 students in the United States have taken at least one PLTW course.

RESULTS

PLTW alumni are studying engineering and technology at colleges and universities at rates approximately five to ten times the average of all U.S. students. They also have higher retention rates in college engineering, science, and related programs than other students in these areas.

TEACHERS

Teachers play a critical role in PLTW's success with students. Since 1997, PLTW has trained approximately 13,000 teachers to teach its courses. PLTW supports teachers with an ongoing professional development model based upon its curriculum. Its Virtual Academy is a robust online resource to which teachers may turn for guidance.

COLLEGES & UNIVERSITIES

PLTW has relationships with more than 100 colleges and universities. Of these, 36 offer credit to students for completion of select PLTW courses.

ECONOMIC STIMULUS

Among the biggest hurdles for new schools is the ability to secure capital for classroom technology. Some states have plans to include PLTW as a "centerpiece" in ARRA Race to the Top applications.

BIOMEDICAL SCIENCES PROGRAM



A shortage of qualified science and health professionals prompted Indiana's Department of Workforce Development and the Connecticut, Maryland, Missouri, Ohio, Oklahoma, and South Carolina State Departments of Education to approach PLTW about starting a Biomedical Sciences program separate from, but similar in structure to, PLTW's Engineering program. State departments of education, offices of workforce development, and business leaders recognized the need for quality instructional programs to prepare students for the rigor of postsecondary biomedical sciences training and funded the program's initial development. During the 2007-08 school year, the first course, Principles of the Biomedical Sciences, was field-tested in 42 schools in the seven states that provided funding for the development of the program. For the 2008-09 school year, the first course was available nationwide.

The PLTW Biomedical Sciences program consists of a sequence of four high school courses that are taken along with college-preparatory mathematics and science courses:

1. Principles of the Biomedical Sciences
2. Human Body Systems
3. Medical Interventions
4. Biomedical Innovation

Students can begin the Biomedical Sciences program in 9th, 10th, or 11th grade and take one course each year or they can double up and take two consecutive courses simultaneously.

The Biomedical Sciences program provides students with an understanding of the role of the biomedical sciences in the modern world and prepares them for careers in the rapidly growing biomedical sciences field. The four courses present a broad foundation in science and healthcare and include specialized knowledge in such areas as: molecular biology, genetics, biochemistry, microbiology, physiology, anatomy, and public health. Students also gain an awareness of the social, legal, and ethical issues surrounding technological advances related to the biomedical sciences.

While the coursework is intentionally rigorous with an emphasis on scientific principles and medical research, the students are exposed to key concepts that will transfer to many fields. Students who complete the Biomedical Sciences courses will graduate being able to do the following:

- Communicate effectively both orally and in writing.
- Think critically.
- Practice professional conduct.
- Work effectively in teams.
- Understand how medical and scientific research is conducted and funded.
- Understand the interdisciplinary nature of science, healthcare, mathematics, and English language arts.

The PLTW Biomedical Sciences program uses a combination of activity-, project-, and problem-based (APPB) learning styles to engage students as they learn to solve problems, participate as part of a team, lead teams, conduct research, analyze data, and learn through fieldwork.

PROGRAM COURSE DESCRIPTIONS



PRINCIPLES OF THE BIOMEDICAL SCIENCES (PBS)

Student work involves the study of human medicine, research processes, an introduction to bioinformatics, and the use of computer science, mathematics, and information theory to model and analyze biological systems. Students investigate the human body systems and 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 life-style choices and medical treatments that might have prolonged the person's life. Key biological concepts including homeostasis, metabolism, inheritance of traits, feedback systems, and defense against disease are embedded in the curriculum. Engineering principles including the design process, feedback loops, and the relationship of structure to function are incorporated in the curriculum. This course is designed to provide an overview of all the courses in the Biomedical Sciences program and lay the scientific foundation for subsequent courses.

HUMAN BODY SYSTEMS (HBS)

Students engage in the study of the processes, structures, and interactions of the human body systems. Important concepts in the course include: communication, transport of substances, locomotion, metabolic processes, defense, and protection. The central theme is how the body systems work together to maintain homeostasis and good health. The systems are studied as "parts of a whole," working together to keep the amazing human machine functioning at an optimal level. Students design experiments, investigate the structures and functions of body systems, and use data acquisition software to monitor body functions such as muscle movement, reflex and voluntary actions, and respiratory operation. Students work through interesting real-world cases and play the role of biomedical professionals to solve medical mysteries.

MEDICAL INTERVENTIONS (MI)

Students investigate a variety of interventions involved in the prevention, diagnosis and treatment of disease as they follow the lives of a fictitious family. The course is a "How-To" manual for maintaining overall health and homeostasis in the body as students explore how to prevent and fight infection; how to screen and evaluate the code in human DNA; how to prevent, diagnose and treat cancer; and how to prevail when the organs of the body begin to fail. These scenarios expose students to the wide range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics. Each family case scenario introduces multiple types of interventions and reinforces concepts learned in the previous two courses, as well as presenting new content. Interventions may range from simple diagnostic tests to treatment of complex diseases and disorders. These interventions are showcased across generations of a family and provide a look at the past, present and future of biomedical sciences. Lifestyle choices and preventive measures are emphasized throughout the course as are the important roles scientific thinking and engineering design play in the development of interventions of the future.

BIOMEDICAL INNOVATION (BI)

Students apply their knowledge and skills to answer questions and solve problems related to the biomedical sciences. In this capstone course, they may consult with a mentor or advisor from a university, hospital, physician's office, or industry. Students are expected to present the results of their work to an adult audience, which may include representatives from the local healthcare or business community or the school's Partnership Team.

ADMINISTRATOR & COUNSELOR INFORMATION



WHO SHOULD TAKE PLTW COURSES?

All students interested in pursuing a career in biological sciences, emergency services, healthcare, or medicine should take the courses. As with the PLTW Engineering program, the rigorous curriculum uses the APPB mode of learning that's grounded in real-world relevance. The APPB approach addresses the learning styles and needs of the majority of students. The courses are hands-on and allow students to apply the concepts they learn in other science and mathematics courses.

WHAT ARE THE PREREQUISITES FOR THE BIOMEDICAL SCIENCES COURSES?

There are no prerequisites for the Principles of the Biomedical Sciences course. For all other courses, the prerequisites are the courses earlier in the series. Students may double up and take more than one PLTW Biomedical Sciences course in a year. If students start the program in 10th grade, it is recommended that they take one course per year until their senior year, when they take both Medical Interventions and Biomedical Innovation. All four courses give students a well-rounded experience in the Biomedical Sciences.

WHAT ARE THE REQUISITE COURSES?

Students enrolled in the PLTW Biomedical Sciences courses must also be enrolled in college-preparatory mathematics and science courses. PLTW Biomedical Sciences courses are not designed to replace traditional science courses; they are designed to enhance them and to focus on concepts directly related to biomedical science.

WHAT ARE THE ATTRIBUTES OF PROGRAM GRADUATES?

- Critical thinking skills and enhanced creativity
- Problem-solving skills
- Effective communication skills
- Professional conduct
- Team players

WHAT ARE SOME SUCCESSFUL METHODS FOR RECRUITMENT?

- Provide teachers with PLTW promotional materials to distribute to their students.
- Encourage PLTW teachers to attend and present at parent/student orientations and other district/community meetings.
- Set up window displays showing a diverse population of students involved in various careers related to the biomedical sciences.
- Provide students the opportunity to explore biomedical science careers.
- Invite parents and students to learn more about the PLTW program through various promotional materials.
- Involve members of the community by inviting professionals in the biomedical sciences to bring their expertise and guidance to the students and in the process enhance their support of the program.
- Use press releases to local newspapers and other media outlets in order to generate community awareness of the PLTW programs.

WHAT IS A PARTNERSHIP TEAM?

A Partnership Team is an advisory board comprised of teachers, representatives from colleges and universities, healthcare providers, advisors from scientific, medical, and technology industries, and local community members. This group supports the PLTW program, addresses issues arising from the implementation of the program, mentors student teams, and speaks to students about the biomedical sciences.



ADMINISTRATOR & COUNSELOR INFORMATION (CONTINUED)

WHO SHOULD TEACH PLTW COURSES?

The school district shall recommend teachers for participation in the PLTW professional development program. Teachers instructing PLTW Biomedical Sciences courses must have successfully completed at least two semesters of college biology with laboratory experience.

WHAT IS A SCHOOL DISTRICT DELEGATE?

Each district office designates its own PLTW School District Delegate to be the liaison between PLTW and the entire district, including all schools implementing a PLTW program. In many districts, the Career and Technical Education (CTE) coordinator also serves as the delegate. The School District Delegate is responsible for the following:

- Verifying the accuracy and completeness of district information in the PLTW database, and ensuring that all schools within the district teaching PLTW courses are registered
- Acting as liaison between PLTW and the district superintendent's office with the processing of the School District Agreement and the school board of education approval process
- Assisting new teachers in registering with PLTW and enrolling in Core Training
- Managing district and school data in the PLTW database to confirm accuracy

ARE THERE ANY ADDITIONAL COSTS TO IMPLEMENT THE PLTW BIOMEDICAL SCIENCES PROGRAM?

Yes. All schools must pay an annual participation fee, currently \$2,000, in order to implement the PLTW Biomedical Sciences program. Schools located in one of the seven states that helped to fund the Biomedical Sciences program development (CT, IN, MD, MO, OH, OK, and SC) receive a \$1,000 per school credit toward the participation fee until the total value of the credits equals the amount of the state's investment in the program.

WHAT IS CORE TRAINING?

Until 2009, training took place exclusively during the summer months and was referred to by PLTW as Summer Training Institute (STI). As 2009 comes to a close, Core Training will take the place of STI as the name of PLTW's professional development division, with STIs continuing to take place during the summer months. Year-round training will allow PLTW to accommodate more teachers and schools. As with STIs, Core Training is offered through our Affiliate Universities. Core Training includes intense training of the PLTW teaching model and course content. Only upon successful completion of Core Training may a teacher instruct that PLTW course. In order to register for a Core Training course, teachers must earn a score of at least 75% on a pre-assessment for that course.

SAMPLE STUDENT SCHEDULE



GRADE 9	GRADE 10	GRADE 11	GRADE 12
English	English	English	English
Social Studies	Social Studies	Social Studies	Social Studies
College-prep Mathematics	College-prep Mathematics	College-prep Mathematics	College-prep Mathematics
College-prep Science	College-prep Science	College-prep Science	College-prep Science
Principles of the Biomedical Sciences	Human Body Systems	Medical Interventions	Biomedical Innovation
Foreign Language	Foreign Language	Fine Arts	Elective
Physical Education	Health	Technology Education	Elective

Note: This schedule assumes students take seven courses per year. If the school is on block scheduling or otherwise allows students to take eight courses per year, additional courses can be added to the schedule.

NATIONAL SCIENCE EDUCATION STANDARDS & PRINCIPLES OF THE BIOMEDICAL SCIENCES



	STANDARDS COVERED IN THE PBS COURSE	STANDARDS NOT COVERED IN THE PBS COURSE
CONTENT STANDARD A: Science as Inquiry		
SKILLS AND PROCESSES FOR BIOLOGY	<ul style="list-style-type: none"> • Form hypotheses, design & execute multiple experiments, analyze data, & write reports. • Use a variety of instruments including: LabVIEW software, Vernier probes, microscopes, electrophoresis equipment, & computers. 	<ul style="list-style-type: none"> • PBS covers all the expectations for Content Standard A.
CONTENT STANDARD C: Life Science		
THE CELL	<ul style="list-style-type: none"> • Cell functions involve chemical reactions. • Cell functions are regulated. • Cells store & use information to guide their functions—DNA & protein synthesis. • Cells can differentiate. 	<ul style="list-style-type: none"> • Cell organelles. • Plant cells.
THE MOLECULAR BASIS OF HEREDITY	<ul style="list-style-type: none"> • Structure & function of DNA. • Human cells contain 23 pairs of chromosomes. • Mutations. • Expression of traits. 	<ul style="list-style-type: none"> • PBS covers the main concepts of this area.
BIOLOGICAL EVOLUTION	<ul style="list-style-type: none"> • PBS does not directly address the concepts in this area. 	<ul style="list-style-type: none"> • Species evolve over time. • Diversity of organisms. • Natural selection. • Common ancestry. • Biological classification.
INTERDEPENDENCE OF ORGANISMS	<ul style="list-style-type: none"> • Atoms & molecules cycle. 	<ul style="list-style-type: none"> • Energy flow through biosphere. • Organisms cooperate & compete. • Population limits. • Human beings modify environments.
MATTER, ENERGY, & ORGANIZATION IN LIVING SYSTEMS	<ul style="list-style-type: none"> • Chemical bonds of food molecules contain energy. • Complexity & organization of organisms accommodates the needs for life functions. 	<ul style="list-style-type: none"> • All matter tends toward disorganization. • Energy for life derived from sun. • Flow of energy & matter through ecosystems.
BEHAVIOR OF ORGANISMS	<ul style="list-style-type: none"> • Human nervous system. 	<ul style="list-style-type: none"> • Structure of nerves. • Sense organs. • Learned or innate behavior. • Evolution of behavior.

STEPS TO A SUCCESSFUL IMPLEMENTATION



FALL 2009

- Visit the PLTW website to learn more about the program.
- Contact your PLTW State Leader with questions or to find out more information.
- Visit schools currently implementing the program.
- For federal funding information, read Education and America's Economic Recovery: Project Lead The Way's Critical Role and Plan for Immediate Action.
- Use promotional materials to increase awareness about the program.
- Select a School District Delegate.
- Complete the New Program Online Registration for the school district and schools that will be implementing the PLTW program for 2010-11. Registration will open in September 2009 and will close on March 1, 2010.
- Return School District Agreement signed by the superintendent and approved by the school board, to the PLTW National Office by May 1, 2010.
- Review equipment and supply needs to create a multiyear budget.
- Send school counselors and administrators to a Counselor Conference.

SPRING 2010

- Identify teachers who meet the requirements set by PLTW and are best suited to teach the courses.
- Complete online teacher registration (once the signed school district agreement has been returned).
- Register teachers for Core Training (registration for Summer Training Institutes opens on March 15, 2010).
- Return signed Software Lease Agreement.
- Send purchase order for the appropriate software to the PTLW National Office.
- Purchase supplies and equipment using the PLTW Biomedical Sciences Purchasing Manual.
- Pay the appropriate participation fee for each school according to the PLTW invoice.

SUMMER 2010

- Teachers attend the appropriate Summer Training Institute.
- Check to ensure all equipment and supplies have been ordered.
- Load required software on classroom computers.

UNIVERSITY AFFILIATES



Arkansas Tech University
Duke University
Eastern Michigan University
Georgia Southern University
Indiana University Purdue University Indianapolis
Iowa State University
Milwaukee School of Engineering
Missouri University of Science & Technology
NHTI, Concord's Community College
New Mexico State University
Northwestern State University of Louisiana
Oklahoma State University
Old Dominion University
Oregon Institute of Technology
Penn State University
Purdue University
Rochester Institute of Technology
Rowan University
San Diego State University
Seattle University
Sinclair Community College
Stevenson University
University of Colorado at Colorado Springs
University of Illinois
University of Iowa
University of Kentucky
University of Maryland at Baltimore County
University of Minnesota
University of New Haven
University of Nebraska – Lincoln
University of South Carolina
University of Tennessee at Chattanooga
University of Texas at Tyler
West Virginia University
Wichita State University
Worcester Polytechnic Institute

PLTW PARTNERS



BUSINESS PARTNERS

Autodesk
Cengage Learning
Edgecam
Fischertechnik
Intelitek
National Instruments
Stratasys/Dimension

SPONSORS

3M
American Electric Power
Amgen
Cargill
Chevron
Intel
Lockheed Martin
Northrop Grumman
Qualcomm
Rockwell Automation
Rolls-Royce
Sprint
Time Warner Cable

EDUCATION INITIATIVES

Academy of Engineering Collaboration (AOE)
American Society for Engineering Education (ASEE)
Engineering Equity Extension Service (EEES)
Gateway Academy
NASA Goddard Space Flight Center
NASA Dryden Flight Research Center
National Council for Agricultural Education (NCAE)
Society of Manufacturing Engineers Education Foundation (SME-EF)
Southern Regional Education Board (SREB)
U.S. Army

FOUNDATIONS

Ewing Marion Kauffman Foundation
John S. and James L. Knight Foundation
Kern Family Foundation

INDUSTRY ASSOCIATIONS

Aerospace Industries Association/
National Defense Industrial Association

Project Lead The Way, Inc.
Clifton Park, NY

<http://www.pltw.org>

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