

Engineering (PLTW)





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The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Engineering - PLTW Program of Study. The academic standards in this document are theoretical and performance-based. The standards contain content from Colorado, Maryland, Tennessee, and Texas and were validated by D.C. business and industry partners. All content is used with permission.

In addition to academic standards, OSSE has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level.

This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.



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Course Descriptions: Engineering (PLTW)		
Course Level	Course Information	Description
Level I	Introduction to Engineering Design OSSEID: 21017G1.0014 Grades: 9-12 Prerequisite: None Credit: 1	Students in Introduction to Engineering dig deep into the engineering design process, applying math, science, and engineering standards to hands-on projects. They work both individually and in teams to design solutions to a variety of problems using 3-D modeling software and use an engineering notebook to document their work.
Level II	Principles of Engineering OSSEID: 21018G1.0024 Grades: 10-12 Prerequisite: Introduction to Engineering Design Credit: 1	Through problems that engage and challenge, students in Principles of Engineering explore a broad range of engineering topics, including mechanisms, the strength of structures and materials, and automation. Students develop skills in problem-solving, research, and design while learning strategies for design process documentation, collaboration, and presentation.
Level III	Aerospace Engineering OSSEID: 21019G1.0034 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	Aerospace Engineering propels students' learning in the fundamentals of atmospheric and space flight. As they explore the physics of flight, students bring the concepts to life by designing an airfoil, propulsion system, and rockets. They learn basic orbital mechanics using industry-standard software. They also explore robot systems through projects such as remotely operated vehicles.
Level III	Civil Engineering and Architecture OSSEID: 21021G1.0034 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	Students in Civil Engineering and Architecture 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.
Level III	Computer Integrated Manufacturing OSSEID: 21022G1.0034 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	Manufactured items are part of everyday life, yet most students have not been introduced to the high-tech, innovative nature of modern manufacturing. Computer Integrated Manufacturing illuminates the opportunities related to understanding manufacturing. At the same time, it teaches students about manufacturing processes, product design, robotics, and automation. Students can earn a virtual manufacturing badge recognized by the National Manufacturing Badge system.
Level III	Computer Science and Software Engineering OSSEID: 10015G1.0034 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	Using Python® as a primary tool and incorporating multiple platforms and languages for computation, Computer Science and Software Engineering PLTW aims to develop computational thinking, generate excitement about career paths that utilize computing, and introduce professional tools that foster creativity and collaboration.



		This course can be a student’s first course in computer science, although we encourage students without prior computing experience to start with Introduction to Computer Science. CSE helps students develop programming expertise and explore the workings of the Internet. Projects and problems include app development, visualization of data, cybersecurity, and simulation. This course aligns with the AP Computer Science Principles course.
Level III	Digital Electronics OSSEID: 5150503 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	From smartphones to appliances, digital circuits are all around us. Digital Electronics provides a foundation for students who are interested in electrical engineering, electronics, or circuit design. Students study topics such as combinational and sequential logic and are exposed to circuit design tools used in industry, including logic gates, integrated circuits, and programmable logic devices.
Level III	Environmental Sustainability OSSEID: 21024G1.0034 Grades: 11-12 Prerequisite: Principles of Engineering Credit: 1	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.
Level IV	Engineering Design and Development OSSEID: 21025G1.0044 Grades: 12 Prerequisite: Aerospace Engineering OR, Civil Engineering and Architecture OR, Computer Integrated Manufacturing OR, Computer Science Principles OR, Digital Electronics OR, Environmental Sustainability Credit: 1	The knowledge and skills students acquire throughout PLTW Engineering come together in Engineering Design and Development as they identify an issue and then research, design, and test a solution, ultimately presenting their solution to a panel of engineers. Students apply the professional skills they have developed to document a design process to standards, completing Engineering Design and Development ready to take on any post-secondary program or career.

Industry Certifications

- Autodesk Certified Professional (ACP) in AutoCAD
- Autodesk Certified User (ACU) in AutoCAD
- Autodesk Certified Professional (ACP) in Revit Architecture
- Autodesk Certified Professional (ACP) in Revit MEP Electrical



Work-Based Learning Examples and Resources

Level I Course	Level II Course	Level III Course	Level IV Course
Career Exploration Industry Visits Guest Speakers Participate in a CTSO	Career Awareness <i>All of Level I, plus:</i> Postsecondary Visits Program- Specific Site Tours Mock Interviews	Career Preparation <i>All of Level I and II, plus:</i> Job Shadow Paid/Unpaid Internships	Career Preparation Paid/Unpaid Internships Apprenticeships

Several resources are available to help instructors meet the Level I and Level II WBL requirements, including:

Career Coach DC (<http://careercoachdc.emsicc.com>). Online site designed to help students find and connect to a career pathway by providing the most current local data on wages, employment, job postings, and associated education and training. The resource includes a Career Assessment for students.

Nepriis (<https://dc.nepriis.com/>). Connects educators and learners with a network of industry professionals virtually, bringing real-world relevance and career exposure to all students. Nepriis also provides a skills-based volunteering platform for business and industry professionals to extend their educational outreach.

Virtual Job Shadow (<https://virtualjobshadow.com>). Provides interactive tools which empower students to discover, plan, and pursue their dreams. Rich video library presents a “day in the life of” view for thousands of occupations.



Labor Market Information Definitions and Data

Career and Technical Education programs of study in the District of Columbia must meet at least one of the High Wage, High Skill, and In-Demand definitions below to be considered appropriate for our students and the regional labor market. These definitions were created in collaboration with Career and Technical Education leaders from District of Columbia LEAs, the University of the District of Columbia Community College, and national guidance from Research Triangle International (RTI) and Education Northwest. Additionally, previous work was consulted by researchers at MIT's Labor Wage Index Project and the DC CTE Task Force's 2012 Strategic Plan for the District of Columbia.

Indicator	Definition	Data for the Engineering (PLTW) Program of Study (source: EMSI, August 2022)
<p>High Wage</p>	<p>Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the District of Columbia, and/or leads to a position that pays at least the median hourly or annual wage for the Washington, DC, metropolitan statistical area.</p> <p><i>Note: A 25th percentile hourly wage of \$23.13 or greater is required to meet this definition.</i></p>	<p>Standard Occupational Code (SOC): 17-2000.00 Engineers</p> <p>Hourly Wages 25th Percentile: \$44.10 50th Percentile: \$57.80 75th Percentile: \$74.74</p>
<p>High Skill</p>	<p>Those occupations located within the Washington, DC, metropolitan statistical area with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, or higher.</p>	<p>Typical Entry-Level Education: Bachelor's Degree</p>
<p>In-Demand</p>	<p>Those occupations in the Washington, DC, metropolitan statistical area having more than the median number of total (growth plus replacement) annual openings over a five-year period.</p> <p><i>Note: An occupation is required to have an annual growth plus replacement rate of 105 openings, or greater, between 2021-2026 to meet this definition.</i></p>	<p>Annual Openings: 2,799</p>



Model Six-Year Plan: Aerospace Engineering - PLTW

College: University of the District of Columbia Community College

Entity: Office of the State Superintendent of Education

Program/CIP:

Career Cluster: STEM

Plan:

Program of Study: Engineering (PLTW)

High School					College			
Subject	9 th Grade	10 th Grade	11 th Grade	12 th Grade	Semester I	Semester II	Semester III	Semester IV
English (4)	English I	English II	English III	English IV				
Math (4)	Algebra I	Geometry	Algebra II	Math				
Science (4)	Biology	Lab Science	Anatomy and Physiology	Science				
Social Studies (4)	World History and Geography I: Middle Ages	World History and Geography II: Modern World	U.S. History	U.S. Government (.5) and D.C. History (.5)				
Health (.5) and Physical Ed (1)	Health (.5) Physical Ed (.5)	Physical Ed (.5)						
World Languages (2)			World Language I	World Language II				
Art (.5)		Art (.5)						
Music (.5)		Music (.5)						
Elective / Major Courses	Introduction to Engineering Design	Principles of Engineering	Aerospace Engineering Civil Engineering and Architecture Computer Integrated Manufacturing Computer Science Principles Digital Electronics Environmental Sustainability	Engineering Design and Development				
Total possible college credits completed in high school: XX					Credit hours required to complete the AAS program: XX			



Course Standards

Introduction to Engineering Design

1. **General requirements.** This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Students in Introduction to Engineering dig deep into the engineering design process, applying math, science, and engineering standards to hands-on projects. They work both individually and in teams to design solutions to a variety of problems using 3-D modeling software and use an engineering notebook to document their work.
 - D. Students will participate in at least two Career Exploration Work-Based Learning experiences in this course, which might include guest speakers and work-place tours relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Introduction to Engineering Design are prescribed in the Project Lead the Way publication: Introduction to Engineering Design, published by Project Lead the Way.



Principles of Engineering

1. **General requirements.** This course is recommended for students in Grades 10-12. Prerequisite: Introduction to Engineering Design. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Through problems that engage and challenge, students in Principles of Engineering explore a broad range of engineering topics, including mechanisms, the strength of structures and materials, and automation. Students develop skills in problem solving, research, and design while learning strategies for design process documentation, collaboration, and presentation.
 - D. Students will participate in at least two Career Awareness Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Principles of Engineering are prescribed in the Project Lead the Way publication: Principles of Engineering, published by Project Lead the Way.



Aerospace Engineering

1. **General requirements.** This course is recommended for students in Grade 11-12. Prerequisite: Principles of Engineering. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Aerospace Engineering propels students' learning in the fundamentals of atmospheric and space flight. As they explore the physics of flight, students bring the concepts to life by designing an airfoil, propulsion system, and rockets. They learn basic orbital mechanics using industry-standard software. They also explore robot systems through projects such as remotely operated vehicles.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Aerospace Engineering are prescribed in the Project Lead the Way publication: Aerospace Engineering, published by Project Lead the Way.



Civil Engineering and Architecture

4. **General requirements.** This course is recommended for students in Grade 11-12. Prerequisite: Principles of Engineering. Students shall be awarded one credit for successful completion of this course.
5. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Students in Civil Engineering and Architecture 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.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
6. **Knowledge and Skills.** Content requirements for Project Lead the Way Civil Engineering and Architecture program of study are prescribed in the Project Lead the Way publication: Civil Engineering and Architecture, published by Project Lead the Way.



Computer Integrated Manufacturing

7. **General requirements.** This course is recommended for students in Grade 11-12. Prerequisite: Principles of Engineering. Students shall be awarded one credit for successful completion of this course.
8. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Manufactured items are part of everyday life, yet most students have not been introduced to the high-tech, innovative nature of modern manufacturing. Computer Integrated Manufacturing illuminates the opportunities related to understanding manufacturing. At the same time, it teaches students about manufacturing processes, product design, robotics, and automation. Students can earn a virtual manufacturing badge recognized by the National Manufacturing Badge system.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
9. **Knowledge and Skills.** Content requirements for Project Lead the Way Computer Integrated Manufacturing are prescribed in the Project Lead the Way publication: Computer Integrated Manufacturing, published by Project Lead the Way.



Computer Science Principles

1. **General requirements.** This course is recommended for students in Grades 10-12. Prerequisite: Computer Science Essentials or Introduction to Engineering. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
 - C. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - D. Computer Science Principles helps students develop programming expertise and explore the workings of the Internet. Projects and problems include app development, visualization of data, cybersecurity, and simulation. PLTW is recognized by the College Board as an endorsed provider of curriculum and professional development for AP[®] Computer Science Principles (AP CSP). This endorsement affirms that all components of PLTW CSP's offerings are aligned to the AP Curriculum Framework standards and the AP CSP assessment.
 - E. Students will participate in at least two Career Awareness Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - F. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Computer Science Principles are prescribed in the Project Lead the Way publication: Computer Science Principles, published by Project Lead the Way.



Digital Electronics

1. **General requirements.** This course is recommended for students in Grade 11-12. Prerequisite: Principles of Engineering. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. Digital Electronics propels students' learning in the fundamentals of atmospheric and space flight. As they explore the physics of flight, students bring the concepts to life by designing an airfoil, propulsion system, and rockets. They learn basic orbital mechanics using industry-standard software. They also explore robot systems through projects such as remotely operated vehicles.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Computer Science Principles are prescribed in the Project Lead the Way publication: Computer Science Principles, published by Project Lead the Way.



Environmental Sustainability

1. **General requirements.** This course is recommended for students in Grade 11-12. Prerequisite: Principles of Engineering. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Information Technology (IT) Career Cluster focuses on building linkages in IT occupations for entry level, technical, and professional careers related to the design, development, support, and management of hardware, software, multimedia, and systems integration services.
 - C. 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.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Environmental Sustainability are prescribed in the Project Lead the Way Environmental Sustainability publication: Environmental Sustainability published by Project Lead the Way.



Engineering Design and Development

1. **General requirements.** This course is recommended for students in Grade 12. Prerequisite: Aerospace Engineering; Civil Engineering and Architecture; Computer Integrated Manufacturing; Computer Science Principles; Digital Electronics; or Environmental Sustainability. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Science, Technology, Engineering & Mathematics (STEM) Career Cluster focuses on the planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.
 - C. The knowledge and skills students acquire throughout PLTW Engineering come together in Engineering Design and Development as they identify an issue and then research, design, and test a solution, ultimately presenting their solution to a panel of engineers. Students apply the professional skills they have developed to document a design process to standards, completing Engineering Design and Development ready to take on any post-secondary program or career.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which includes paid or unpaid internship, pre-apprenticeship, or apprenticeship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and Skills.** Content requirements for Project Lead the Way Engineering Design and Development are prescribed in the Project Lead the Way publication: Engineering Design and Development, published by Project Lead the Way.