

# Fulfilling High School Graduation Requirements with Computer Science Coursework

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**COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF EDUCATION**

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**"Computer science education gives Pennsylvania's students - regardless of their age, gender, color, ability level, or zip code - essential skills they need to explore, innovate, and affect positive change in their communities. Computer science is a critical tool in a digital, interconnected, and rapidly evolving world."**

Pedro A. Rivera, Secretary of Education

## **Introduction**

The purpose of this guidance is to assist local educational agencies (LEAs) – including school districts, charter schools, cyber charter schools and area vocational-technical schools – in the implementation of amendments to Section 1605 of the Public School Code.

In an effort to improve access to computer science learning opportunities and pathways for all students, Governor Tom Wolf [signed](#) Act 86 of 2016 (Act 86) into law on July 13, 2016. Section 8 of Act 86 amended section 1605 of the Pennsylvania Public School Code, 24 P.S. § 16-1605, allowing high school students to apply up to one credit towards a math or science high school graduation credit requirement upon successful completion of computer science or information technology coursework. In accordance with Section 1605(c), this law is effective beginning with students graduating from a public high school at the end of the 2016-2017 school year, and continuing each school year thereafter.

The governing body of the student's public high school has discretion to determine the graduation credit requirement to which the credit earned by the student for computer science or information technology coursework is applied. Section 1605 defines a public high school as a school within a school district, a charter school, a cyber-charter school, a regional charter school or an area vocational-technical school, that offers grade 12.

The Act specifically amends [Section 1605 of the Public School Code of 1949](#) as follows:

### **Section 1605 Courses of Study.**

... (c) (1) Beginning with those students graduating from a public high school at the end of the 2016-2017 school year, and continuing in each school year thereafter, a student who successfully completes a course in computer science or information technology during grades nine through twelve shall be permitted to apply up to one credit earned for successful completion of such course to satisfy the student's mathematics or science credit requirement for graduation, provided, that the governing body of the student's public high school shall have discretion to determine the graduation credit requirement to which the credit earned by the student shall be applied.

(2) As used in this subsection, "public high school" shall mean a public school, including a school within a school district, a charter school, a cyber-charter school, a regional charter school or an area vocational-technical school, that offers twelfth grade.

With the enactment of these provisions, Pennsylvania joined 22 other states whose high school graduation requirements accept computer science or information technology coursework.<sup>1</sup>

## Background

Computer science (CS) and information technology (IT) skills, like computational thinking, collaboration, recognizing and defining a problem, generating and using abstractions, testing and refining computational artifacts, design thinking, communicating and collaborating with diverse cultures, are valuable assets in a changing, 21<sup>st</sup> century economy.<sup>2</sup> Computing occupations are the **number one source of all new wages in the U.S.** and make up two-thirds of all projected new jobs in STEM fields, making CS one of the most in-demand skill sets from employers. According to the U.S. Bureau of Labor Statistics, CS and IT jobs are projected to grow by 12 percent between 2012 and 2024.<sup>3</sup> Currently, Pennsylvania has **20,192 open computer science jobs** (3.4 times the average demand rate in Pennsylvania).

While CS skills are essential in a 21<sup>st</sup> century economy, not all students have access to high-quality CS and IT coursework or pathways. Research suggests that students' access to high-quality CS and STEM education varies significantly, and that, too often, students of color, low-income students, and girls are unable to access the opportunities available for their wealthier, white, and male peers.<sup>4</sup> While the number of Pennsylvania high schools offering CS courses persist; the most commonly reported challenges include a lack of qualified teachers and limited scheduling availability because of priority for tested subjects.<sup>5</sup>

As noted earlier, economic opportunities connected to CS and STEM careers continue to expand. Student interest in CS and programming careers is significant; in a recent survey of 1,512 Pennsylvania students, CS and programming careers garnered the most interest of any occupation.<sup>6</sup> However, the opportunities for students to learn about these pathways and be exposed to critical STEM skills, like computational thinking, recognizing a problem and designing a solution, collaborating, communicating, critical thinking, generating arguments based on evidence, and design thinking are limited. Often, experiences that develop STEM skills are dependent on a students' socioeconomic status, race/ethnicity, gender, and/or zip code.

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<sup>1</sup> Jennifer Zinth, *Education Trends: Computer Science in High School Graduation Requirements*, Education Commission of the States, September 2016, [http://www.ecs.org/ec-content/uploads/09.13.2016\\_Computer-Science-in-High-School-Graduation-Requirements.pdf](http://www.ecs.org/ec-content/uploads/09.13.2016_Computer-Science-in-High-School-Graduation-Requirements.pdf).

<sup>2</sup> [K-12 Computer Science Framework | Practices](#)

<sup>3</sup> [http://www.ecs.org/ec-content/uploads/09.13.2016\\_Computer-Science-in-High-School-Graduation-Requirements.pdf](http://www.ecs.org/ec-content/uploads/09.13.2016_Computer-Science-in-High-School-Graduation-Requirements.pdf)

<sup>4</sup> i Diversity Gaps in CS: Exploring the Underrepresentation of Girls, Blacks, and Hispanics, Google, Inc. & Gallup Inc, 2016, <http://services.google.com/fh/files/misc/diversity-gaps-in-computer-science-report.pdf>.

<sup>5</sup> Trends in the State of CS in U.S. K-12 Schools, Google, Inc. & Gallup Inc., 2016,

<http://services.google.com/fh/files/misc/trends-in-the-state-of-computer-science-report.pdf>.

<sup>6</sup> ACT STEM report for Pennsylvania

- Today, there are approximately 17,000 unfilled CS and software development jobs in Pennsylvania,<sup>7</sup> but in 2014, the state had just 2,820 CS graduates; only one in five were women.<sup>8</sup>
- Students who take a CS course in high school are six times more likely to pursue a CS major, and women are 10 times more likely.<sup>9</sup>
- Only 1,559 high school students in Pennsylvania took the AP CS exam in 2015; of those students, only 16 percent were female, only 36 students (2.3 percent) were Hispanic/Latino, and only 58 students (3.7 percent) were black.<sup>10</sup>
- According to a recent ACT STEM Survey, 40 percent of Pennsylvania students display STEM college/career readiness, but only 10 percent of black students show STEM college/career readiness.<sup>11</sup>

## School-Level Implementation

### *Definitions and components of computer science (CS) education*

- ACM/CSTA Model Curriculum for K-12 Computer Science and the K-12 Computer Science Framework defines CS education as the study of computers and algorithmic processes, including their principles, hardware and software designs, applications, and impact on society.<sup>12</sup> The K-12 Computer Science Framework includes in the definition of computing education, computer literacy, educational technology, digital citizenship, information technology, and computer science.
- The K-12 Computer Science Framework focuses CS education on the following core practices: fostering an inclusive computing culture, collaborating around computing, recognizing, and defining computational problems, developing and using abstractions, creating computational artifacts, testing and refining computational artifacts, and communicating about computing.<sup>13</sup>
- The K-12 Computer Science Framework focuses on five core concepts: computing systems, networks and the internet, data analysis, algorithms and programming, and impacts of computing.<sup>14</sup>
- Information Technology (IT) is a broad and diverse set of topics, but typically focuses on applying the components of information technology to solve a problem, such as network or database administration.

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<sup>7</sup> *Support K-12 CS Education in Pennsylvania*. Code.org, <https://code.org/advocacy/state-facts/PA.pdf>

<sup>8</sup> Code.org Pennsylvania fact sheet, <https://code.org/advocacy/state-facts/PA.pdf>.

<sup>9</sup> Ibid.

<sup>10</sup> Code.org Pennsylvania fact sheet

<sup>11</sup> ACT STEM report for Pennsylvania (prepared for PDE staff)

<sup>12</sup> Tucker, A McCowan, D., Deek, F., Stephenson, C., Jones, J., & Vemo, A. (2006). *A model Curriculum for K-12 computer science: Report of the ACEM K-12 task force curriculum committee* (2<sup>nd</sup> ed.) New York, NY: Association for Computing Machinery.

<sup>13</sup> [K-12 Computer Science Framework | Practices](#)

<sup>14</sup> [K-12 Computer Science Framework | Core Concepts](#)

**Locally Developed Approval Process.** In determining whether a course is a computer science course or information technology course, such that a credit or a portion of a credit should be awarded for successful completion of the course, the Pennsylvania Department of Education (PDE) recommends that LEAs consider the following:

- Whether the course was planned instruction aligned with local, state, and/or national content standards for CS or IT;
- The length of the course in relation to the planned instruction;
- The comprehensiveness of the course in relation to the content standards; and
- Whether the student successfully completes the course.

School districts are advised to develop a process by which students in grades 9-12 seek approval to apply a CS or IT course toward math or science graduation requirements. The local policy should also establish specific eligibility criteria for which CS and IT courses could be applied toward math or science graduation requirements. For example, LEAs could consider whether courses of rigor (such as AP Computer Science, IB Computer Science, dual enrollment courses) would be considered eligible CS/IT coursework. Under the law, LEAs are responsible for ensuring that the CS or IT course meets state and local standards for quality and rigor; there is no state-level approval process. The locally developed policy should also consider whether application of coursework earned outside of the school year toward graduation would be permissible (such as summer or postsecondary coursework). PDE recommends that options for CS/IT coursework be consistent with other options for fulfilling graduation requirements under local policy.

**Academic Standards.** Pennsylvania has established [academic standards](#), known as the Pennsylvania Core Standards, that define what students should know and be able to do at different grade levels. These standards, which are part of the Chapter 4 regulations (Academic Standards and Assessment),<sup>15</sup> must be used as the basis for locally developed curriculum, instruction, and assessment in Pennsylvania's public schools. While not required, PDE recommends that schools explore available professional standards and resources, such as the [K-12 Computer Science Framework](#), Computer Science Teachers Association Standards<sup>16</sup>, and International Society for Technology in Education Standards.<sup>17</sup>

**Information Sharing and Data Reporting.** While the law does not require school entities to publish or provide information about graduation requirements, PDE recommends that LEAs consider ways to share options under graduation requirement policy to students, educators, administrators, guidance counselors, parents/families, and other relevant stakeholders. The law also does not require any reporting of data related to students who use CS or IT coursework to satisfy graduation credit requirements.

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<sup>13</sup> Chapter 4 – Academic Standards and Assessment,  
<http://www.pacode.com/secure/data/022/chapter4/chap4toc.html>.

<sup>16</sup> [Computer Science Teacher Associations | K-12 Standards](#)

<sup>17</sup> [International Society for Technology in Education | Standards](#)

**Advising Students on Postsecondary Education.** Recognizing the critical role that postsecondary education plays for ensuring opportunities and success in many career pathways, including CS, IT, and other STEM careers, it is imperative that LEAs also consider the impact that course selection may have on students' ability to successfully pursue postsecondary education, and advise students accordingly. Colleges and universities have varying ways of evaluating CS and IT course credits during the admission process to include acceptance into particular majors. Teachers and school counselors will need to carefully advise students and their families to ensure that their high school credit-bearing course selections and graduation planning career pathways are consistent with admission standards and program requirements for postsecondary education and training.

For more information, contact Ray A. Young, Chief, Bureau of Curriculum, Assessment and Instruction, at 717-783-6633 or [rayyoung@pa.gov](mailto:rayyoung@pa.gov).

## Resources

- [Allegheny Intermediate Unit \(AIU3\)](#) – A comprehensive Intermediate Unit with a wide variety of STEM and computer science resources for educators, students and families across the commonwealth. AIU3 is a localized training partner of Code.org focused on computer science teacher preparation K-6.
- [AP Computer Science A](#) – A course focused on the design and implementation of computer science to solve real world problems.
- [Carnegie Mellon Create Lab](#) – Community Robotics, Education and Technology Empowerment Lab. Focus on empowering citizen scientists and a technologically fluent generation.
- [Code.org](#) - Launched in 2013, Code.org® is a non-profit dedicated to expanding access to computer science, and increasing participation by women and underrepresented students of color.
- [Computer Science Education Week](#) - Computer Science Education Week (CSEdWeek) is an annual program dedicated to inspiring K-12 students to take interest in computer science.
- [Delaware County Intermediate Unit \(DCIU\)](#) - Is a comprehensive Intermediate Unit with a wide variety of STEM and computer science resources for educators, students and families across the commonwealth. DCIU is the regional training partner of Code.org. DCIU is a committed resource for computer science teacher training K-12 across the state.
- [Education Commission of the States](#) – Computer science in High School Graduation Requirements: 2016 Update
- [Exploring Computer Science](#) - Exploring Computer Science is supported by the Broadening Participation in Computing division of the National Science Foundation (Into the Loop). Any opinions, findings, and conclusions or

recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

- **[The Fortress Initiative](#)** – Central Pennsylvania’s first licensed computer coding boot camp.
- **[Google for Education](#)** - A range of resources, programs, scholarships, and grant opportunities to engage students and educators around the world interested in computer science.
- **[International Society for Technology in Education \(ISTE\)](#)** - ISTE is an association for educators and leaders engaged in improving learning and teaching through the effective use of technology. ISTE offers National Educational Technology Standards (NETS) for students, teachers, administrators, technology coaches, and computer science educators.
- **[Massachusetts Digital Literacy and Computer Science Standards \(DRAFT\)](#)** - Voluntary Digital Literacy and Computer Science Standards for Massachusetts schools.
- **[Microsoft TEALS](#)** – Technology Education and Literacy in Schools (TEALS) is a resources for expanding high quality computer science education in high schools across the nation.
- **[PBS LearningMedia](#)** - Developed in partnership with WGBH, PBS LearningMedia provides access to thousands of classroom-ready, curriculum-targeted digital resources. Resources include short videos, interactives, and in-depth lesson plans. Content contributors include 80 PBS member stations, plus include the National Archives, the Jim Henson Company, Annenberg Media, and the Library of Congress.
- **[Pennsylvania Business, Computer and Information Technology Standards](#)** – High school computer science and information technology standards.
- **[Zulama](#)** – An innovative educational organization that provides a unique blend of resources for teachers and students to get them excited about engaging in STEM and computer science.