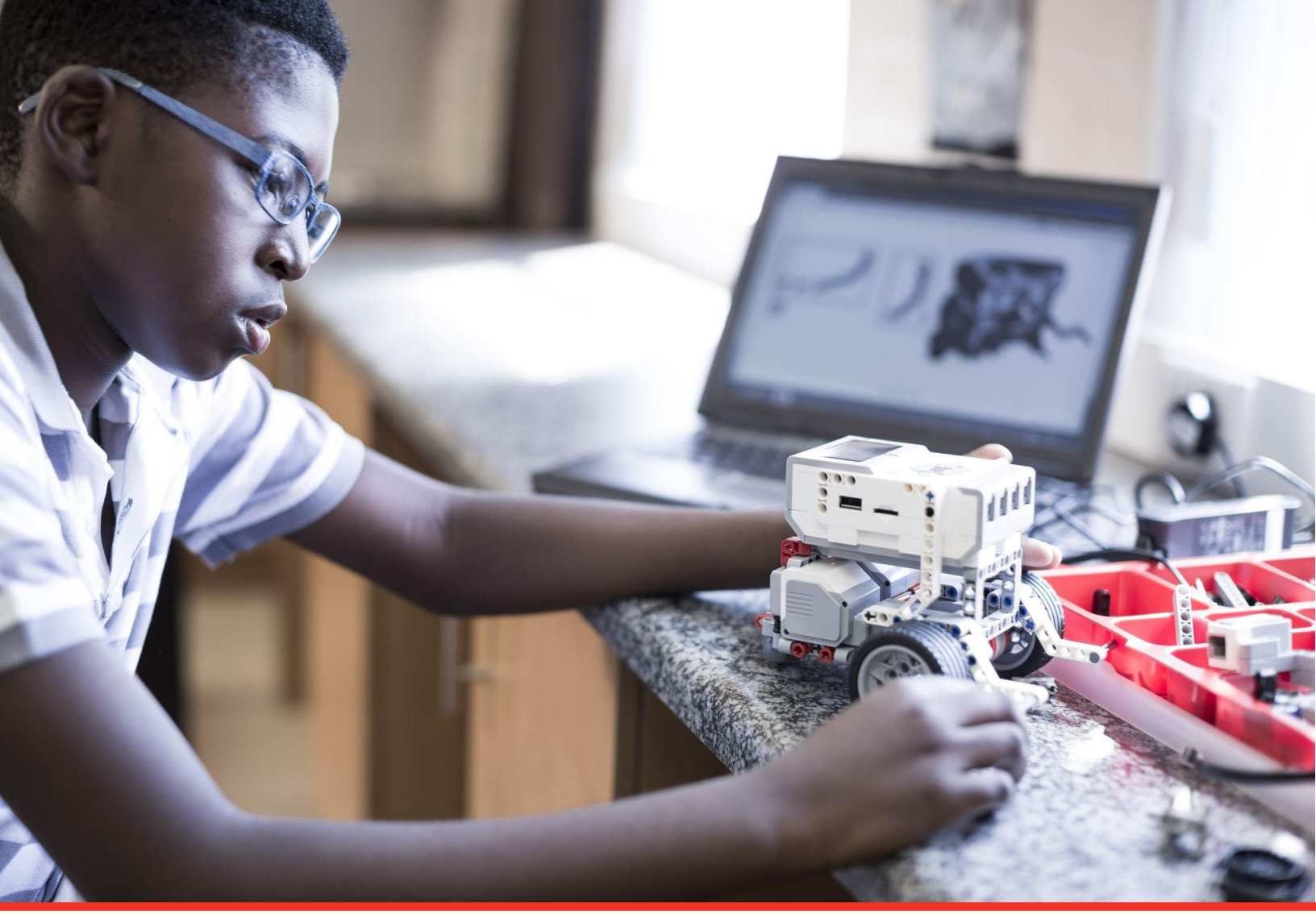

STEM

Comprehensive Career Cluster Review (C3R)

College, Career, & Technical Education | Spring 2024

TN Department of Education

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Comprehensive Career Cluster Review (C3R)

The comprehensive career cluster review (C3R) is the intentional review of career and technical education (CTE) programs and the course standards within each program to ensure students have up-to-date course standards aligned to postsecondary and career needs. Each career cluster is reviewed annually with input from the state-wide advisory councils comprised of postsecondary partners, industry partners, and secondary CTE teachers. Advisory council meetings allow the stakeholders to engage in dialogue and discuss current needs, emerging trends, and necessary course revisions to course standards. Advisory council input could potentially lead to new or retired programs of study, new courses or retired courses, or revised course standards within existing courses, if necessary. The collaborative engagement ensures students receive instruction on the most up-to-date and relevant course standards, so they are prepared for postsecondary and the workforce.

STEM

In Tennessee, the STEM career cluster is pivotal in driving innovation and addressing some of the most pressing challenges of our time. This cluster includes four key programs of study: Advanced STEM Applications, BioSTEM, Engineering, and Technology. Each of these programs is experiencing robust job growth due to the critical nature of the work involved.

The Advanced STEM Applications program is expanding as industries increasingly rely on sophisticated technologies and methodologies to enhance efficiency and productivity. The BioSTEM program sees significant growth driven by the need for professionals who can address public health concerns and develop solutions for medical and environmental challenges. Engineering remains a cornerstone of the STEM field, with a high demand for engineers to design, develop, and maintain the infrastructure and technologies essential for modern society. Lastly, the Technology program is flourishing as businesses and industries seek skilled technologists to innovate and manage cutting-edge systems and processes.

Even during economic downturns, the demand for scientists, technologists, and engineers persists, fueled by the need to meet environmental regulations, develop new methods for mitigating existing hazards, and shift towards preventive measures rather than merely controlling existing problems. The increasing emphasis on sustainability and public health further amplifies the need for STEM professionals in Tennessee, ensuring steady career opportunities in these fields.

School Year	STEM Concentrators
2020-21	5,760
2021-22	5,971
2022-23	7,099

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Advanced STEM Applications

2023-24 Program of Study	Year1	Year 2	Year 3	Year 4
Advanced STEM Applications	STEM I: Foundation (C21H15)	STEM II: Applications (C21H16)	STEM III: STEM in Context (C21H17) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Advanced STEM Applications I (C21H32) -or- **Dual Enrollment** Advanced STEM Applications II (C21H33)	STEM IV: STEM Practicum (C21H18) -or- **AP** Calculus AB (G02H24) -or- **AP** Calculus BC (G02H25) -or- **AP** Computer Science A (G02H45) -or- **AP** Biology (G03H10) -or- **AP** Chemistry (G03H16) -or- **AP** Physics I: Algebra-Based (G03H27) -or- **AP** Physics II: Algebra-Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or- **AP**

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				Physics C: Mechanics (G03H29) -or- **Dual Enrollment** Advanced STEM Applications III (C21H35) -or- **Dual Enrollment** Advanced STEM Applications IV (C21H36) -or- **IB** Biology II SL/HL (G03H69) -or- **IB** Physics II SL (G03H82) -or- **WBL** Advanced STEM Applications Career Practicum (C21H45)

Description

The *Advanced STEM Applications* program of study (POS) is designed for students interested in the exciting careers available in the high-demand fields of science, technology, engineering, and mathematics. This POS is uniquely structured to offer students an overview of STEM fields, occupations, and applications in the first year, followed by a more specialized study of the scientific inquiry or engineering design process in subsequent years, culminating in a portfolio and internship experience. Upon completion of these POS, students will be prepared to pursue engineering studies or an advanced study in the STEM field of their choice at a variety of postsecondary institutions.

This POS is aligned with SkillsUSA and the Technology Student Association (TSA) career and technical student organizations (CTSOs).

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Job Outlook

As the global demand for STEM professionals continues to grow, there is an increasing need for skilled workers in various industries, such as healthcare, information technology, and renewable energy. STEM education prepares students for high-paying jobs by providing them with the knowledge and skills required to excel in these competitive fields. According to the Bureau of Labor Statistics, the overall employment of computer systems analysts is strong statewide and nationally. Nationally, computer systems analysts are projected to grow ten percent from 2022 to 2032, much faster than the average for all occupations[1]. Tennessee is expecting a 28 percent projected growth in employment of computer systems analysts[2].

There are about 37,600 openings for computer systems analysts each year, on average, over the decade[3]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 1. Tennessee employment projections for Advanced STEM Applications related occupations with positive job openings projected 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[4]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
General and Operations Managers	11-1021	46,120	56,270	22%	5,210
Medical and Health Service Managers	11-9111	10,494	14,991	43%	1,415
Computer Systems Analyst	15-1211	10,441	13,313	28%	1,103

[1] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Systems Analyst], at https://www.bls.gov/ooh/computer-and-information-technology/computer-systems-analysts.htm (Visited February 1, 2024

[2] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

[3] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Computer Systems Analyst], at https://www.bls.gov/ooh/computer-and-information-technology/computer-systems-analysts.htm (Visited February 1, 2024

[4] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

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Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Computer User Support Specialists	15-1232	10,264	13,245	29%	1,141
Management Analysts	13-1111	10,305	12,347	20%	1,220
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
Computer Occupations, All Other	15-1299	6,813	8,310	22%	695
Operating Engineers and Other Construction Equipment Operators	47-2073	6,754	7,834	16%	870
Industrial Engineers	17-2112	5,399	6,976	29%	541
Network and Computer Systems Administrators	15-1244	5,250	6,247	19%	467

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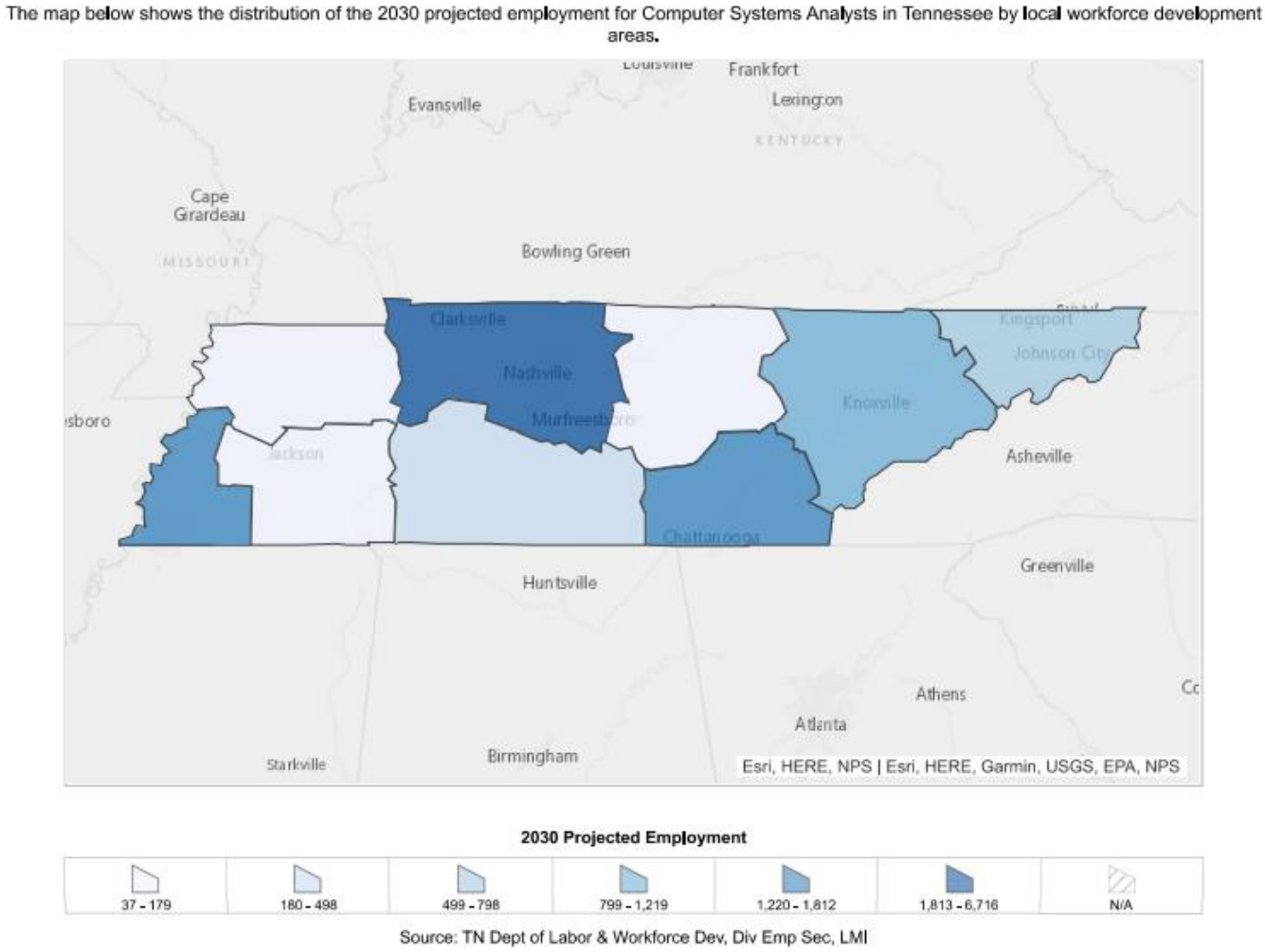
Figure 2. 2020-2030 employment projections for Computer Analysts in Tennessee by region.[5]



[5] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

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Program of Study Level

The Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in career and technical education (CTE) programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

Advanced STEM Applications: Level 3

Postsecondary Pathways

Tennessee offers extensive post-secondary opportunities for students aspiring to specialize in advanced STEM applications. The Tennessee College of Applied Technology (TCAT) plays a pivotal role, offering specialized programs in advanced manufacturing, robotics, and automation, providing students with hands-on training and certifications essential for careers in cutting-edge industries. Community colleges like Chattanooga State Community College and Motlow State Community College also contribute significantly by offering associate degree programs in fields such as mechatronics engineering technology and advanced manufacturing, equipping students with the technical skills and problem-solving abilities needed to thrive in highly technical environments.

Moreover, universities such as the University of Tennessee at Knoxville and Tennessee Technological University offer bachelor's and advanced degree programs in specialized STEM fields like aerospace engineering, nanotechnology, and computational science. These institutions provide opportunities for advanced research, interdisciplinary collaboration, and industry partnerships, preparing graduates to tackle complex challenges and drive innovation in fields such as space exploration, renewable energy, and biomedical engineering. With a diverse range of educational pathways tailored to different interests and career aspirations, Tennessee ensures that aspiring professionals in advanced STEM applications have the resources and support needed to excel in these dynamic and high-impact fields.

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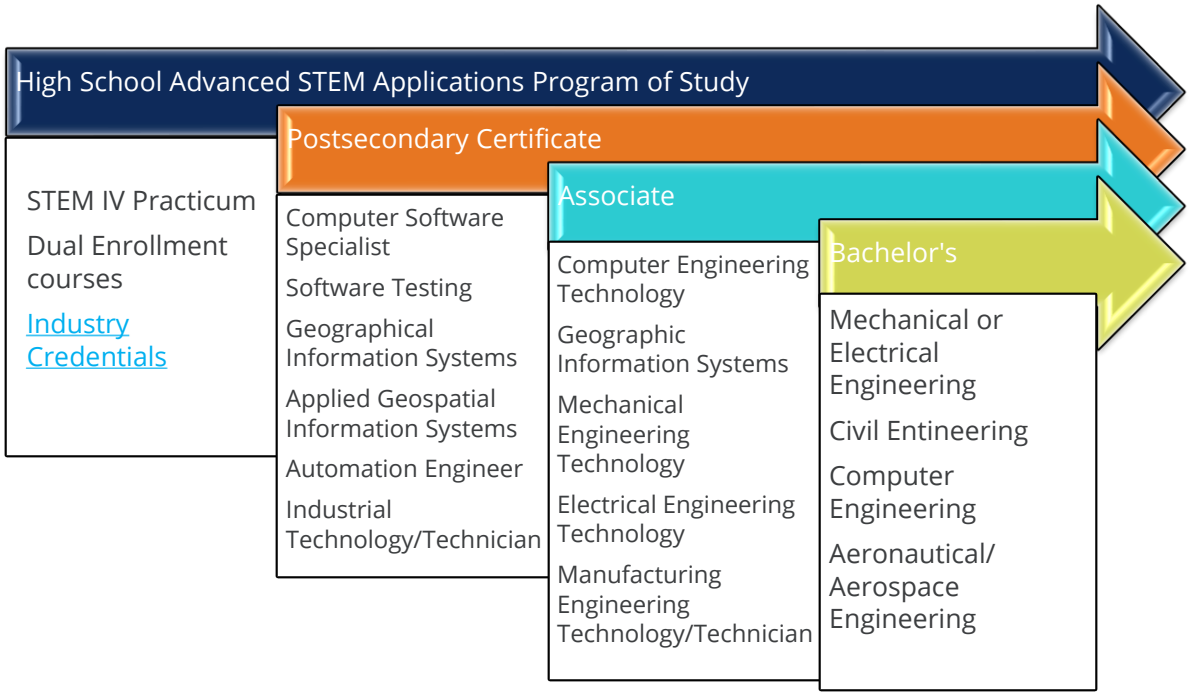
Figure 3. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the [Tennessee Department of Labor and Workforce Dashboard](#).

High School Diploma	Certificate	Associate	Bachelor's
• N/A	• Compter User Support Specialist **(47,960)**	• Electrical Engineering Technician **($58,560)** • Geographic Information Systems Technologist **($59,750)** • Civil Engineering Technologists and Technicians **($39,210)**	• Software Quality Assurance Engineer **($79,960)** • Software Developer **($103,270)** • Mechanical Engineer **($93,650)** • Electrical Engineer **($99,990)** • Civil Engineer **(84,740)**

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Current Secondary Landscape

Over the past three years, the number of schools offering Advanced STEM Applications has increased from 45 to 52. In the 2022-23 school year 7,173 students were enrolled in Advanced STEM Applications which was an increase from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 to the 2022-23 school year as well as the enrollment in Advanced STEM Applications and student concentration in the STEM career cluster.

Figure 4. Open Enrollment Analysis

School Year	Schools Offering Advanced STEM Applications
2020-21	45
2021-22	40
2022-23	52

Figure 5. Student Enrollment by Course

School Year	STEM I: Foundations	STEM II: Applications	STEM III: STEM in Context	STEM Practicum
2020-21	3224	1595	773	410
2021-22	3487	1710	1039	339
2022-23	3777	1682	1233	481

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BioSTEM

2023-24 Program of Study	Year 1	Year 2	Year 3	Year 4
BioSTEM	BioSTEM (C21H07)	BioSTEM II (C21H08)	BioSTEM III (C21H09) -or- **Dual Enrollment** BioSTEM I (C21H37) -or- **Dual Enrollment** BioSTEM II (C21H38)	BioSTEM Practicum (C21H10) -or- **Dual Enrollment** BioSTEM III (C21H39) -or- **Dual Enrollment** BioSTEM IV (C21H40) -or- **WBL** BioSTEM Career Practicum (C21H46)

Description

The *BioSTEM* POS at the high school level is designed to ignite the passion of students interested in exploring careers in science, technology, engineering, and mathematics with a specific focus on biotechnology. Serving as a program of study within the STEM cluster, BioSTEM equips students with essential skills required for success in biotechnological fields. Throughout the course, students engage in a comprehensive exploration of the engineering design and scientific inquiry processes. Proficient students emerge with the ability to identify and articulate the steps involved in both processes, conduct meaningful research, define problem scenarios and scientific investigations, develop fundamental design solutions, perform basic mathematical modeling and data analysis, and effectively communicate solutions and scientific explanations to their peers. The BioSTEM POS provides a solid foundation for future endeavors in the dynamic field of biotechnology.

This POS is aligned with SkillsUSA and (TSA) CTSOs.

Job Outlook

From life-saving therapies and procedures to healthier foods and innovative research, society benefits from a better quality of life because of bioscience. According to the Bureau of Labor Statistics, overall employment of clinical laboratory technologists and technicians is strong both statewide and nationally. Nationally clinical laboratory technologists and technicians are projected to grow five percent from 2022 to

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2032, faster than the average for all occupations[6]. Tennessee is expecting a 20 percent projected growth in employment of clinical laboratory technologists and technicians[7].

There are about 24,000 openings for clinical laboratory technologists and technicians each year, on average, over the decade[8]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 1. Tennessee employment projections for BioSTEM-related occupations with positive job openings projected 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[9]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Registered Nurses	29-1141	64,275	75,149	17%	4,701
General and Operations Managers	11-1021	46,121	56,264	22%	5,210
Licensed Practical and Licensed Vocational Nurses	29-2061	25,617	29,856	17%	2,517
Medical Assistants	31-9092	15,544	18,799	21%	2,313
Medical and Health Service Managers	11-9111	10,494	14,991	43%	1,415
Nurse Practitioners	29-1171	8,184	12,857	57%	1,017
Management Analysts	13-1111	10,305	12,347	20%	1,220
Clinical Laboratory Technologists and Technicians	29-2010	9,642	11,597	20%	864

[6] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Clinical Laboratory Technologist or Technician], at https://www.bls.gov/ooh/healthcare/clinical-laboratory-technologists-and-technicians.htm (Visited February 1, 2024)

[7] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

[8] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Clinical Laboratory Technologist or Technician], at https://www.bls.gov/ooh/healthcare/clinical-laboratory-technologists-and-technicians.htm (Visited February 1, 2024)

[9] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

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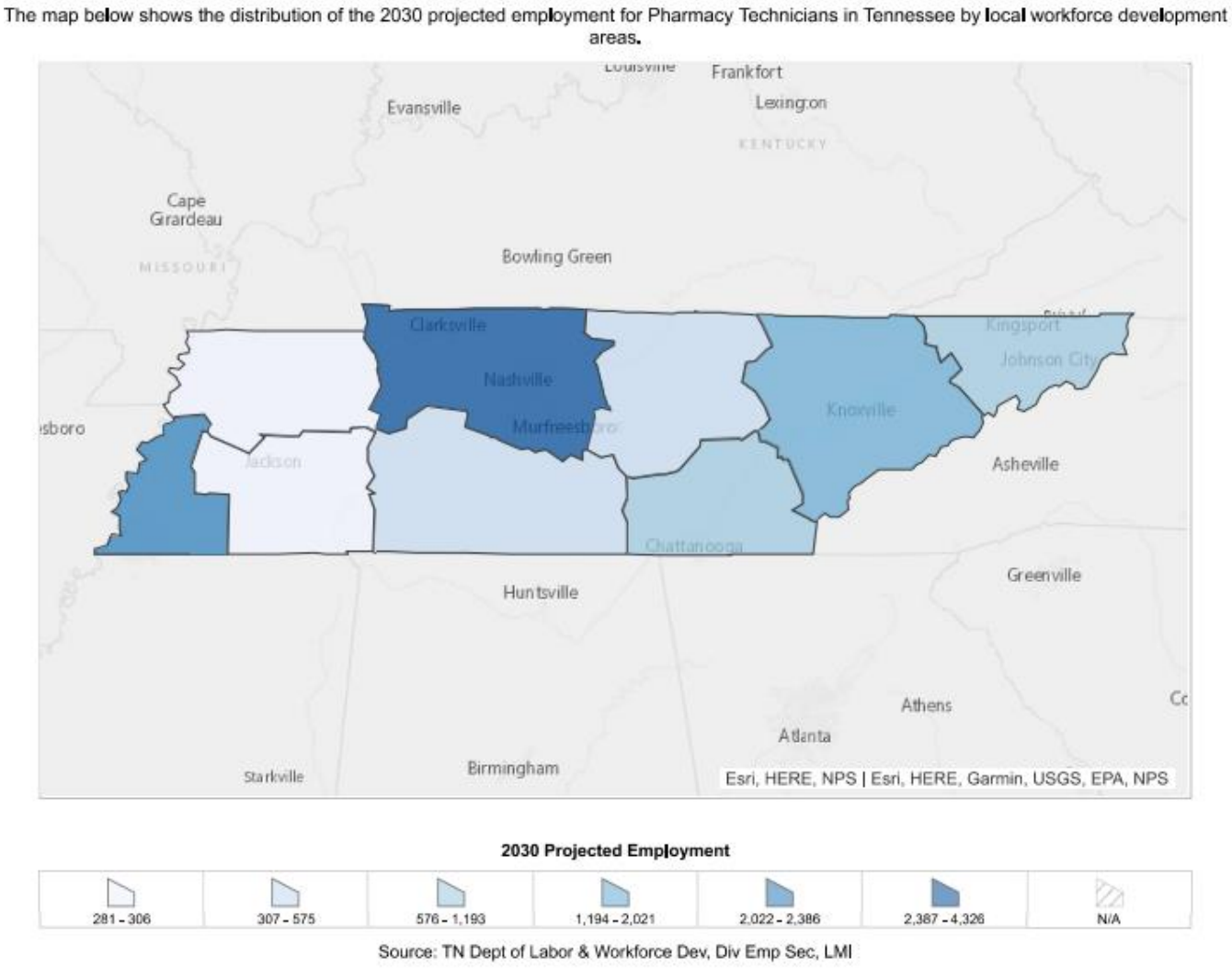
Pharmacy Technicians	29-2052	10,101	11,345	12%	878
Dental Assistants	31-9091	5,586	6,385	14%	772

Figure 2. 2020-2030 Projected employment for Pharmacy Technicians in Tennessee by region.[10]



[10] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

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Program of Study Level

TISA provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

BioSTEM: Level 3

Postsecondary Opportunities

In Tennessee, students with a passion for BioSTEM (Biological Science, Technology, Engineering, and Mathematics) have a diverse array of postsecondary opportunities to explore. The Tennessee College of Applied Technology (TCAT) offers specialized programs in BioSTEM-related fields such as biotechnology and laboratory technology, providing hands-on training in laboratory techniques, instrumentation, and data analysis crucial for careers in the life sciences industry. Community colleges like Roane State Community College and Chattanooga State Community College offer associate degree programs and certificate programs in pharmacy tech, biology, or biotechnology, with coursework covering topics such as genetics, microbiology, and bioinformatics, laying a strong foundation for further study or entry-level positions in the field. Moreover, universities such as the University of Tennessee at Knoxville and Vanderbilt University provide bachelor's and advanced degree programs in BioSTEM disciplines, offering opportunities for research, specialization, and career advancement in areas ranging from biomedical engineering to computational biology. With a range of educational pathways tailored to different interests and career goals, Tennessee ensures that aspiring BioSTEM professionals have the resources and support they need to thrive in this dynamic and rapidly advancing field.

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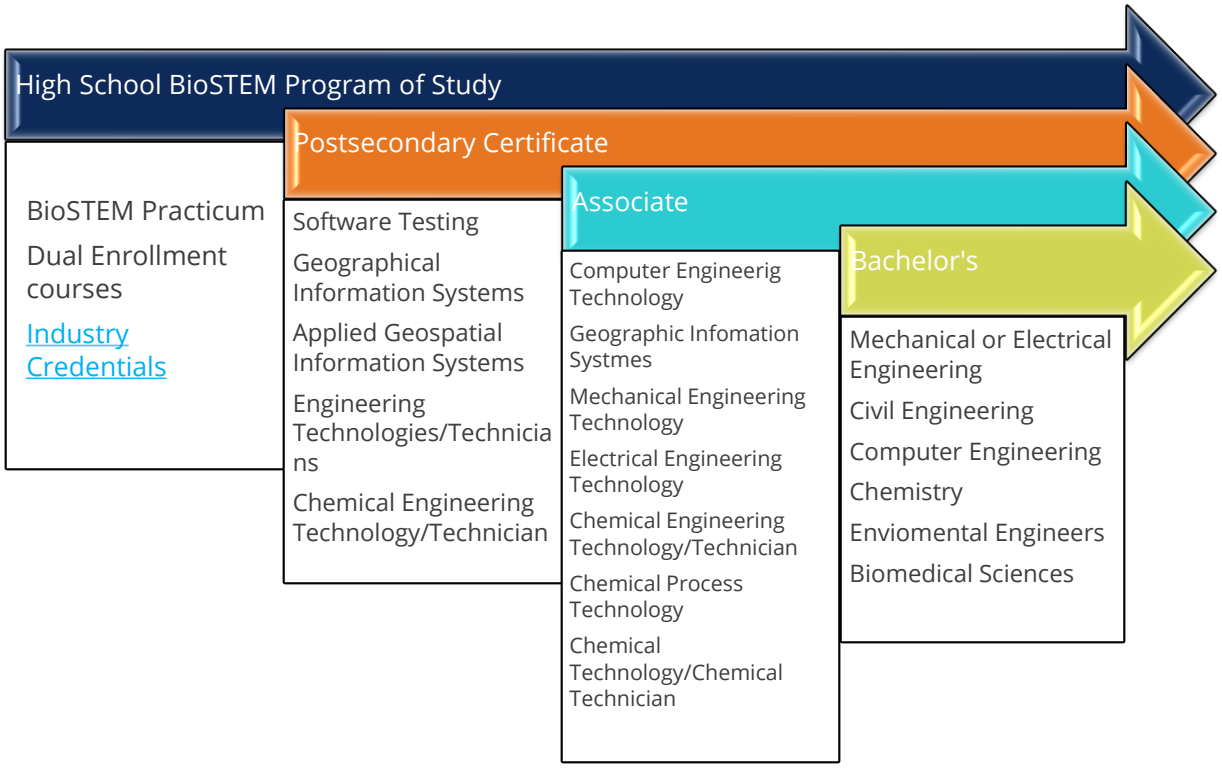
Figure 3. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the [Tennessee Department of Labor and Workforce Dashboard](#).

High School Diploma	Certificate	Associate	Bachelor's
• N/A	• Chemical Technicians **($50,100)** • Pharmacy Technicians **($37,380)**	• Chemical Technicians **($50,100)**	• Environmental Engineers **($97,310)** • Chemists **($68,260)** • Biomedical Engineers **($89,680)** • Biomedical Technicians **($51,430)**

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Current Secondary Landscape

Over the past three years, the number of schools offering BioSTEM has increased from three to eight. In the 2022-23 school year, 758 students were enrolled in BioSTEM, which is an increase from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 to 2022-23 school year as well as the enrollment in BioSTEM and student concentration in the STEM career cluster.

Figure 1. Open Enrollment Analysis

School Year	Schools Offering BioSTEM
2020-21	3
2021-22	4
2022-23	8

Figure 5. Student Enrollment by Course

School Year	BioSTEM I	BioSTEM II	BioSTEM III	BioSTEM Practicum
2020-21	142	38	34	No data
2021-22	440	109	23	No data
2022-23	512	195	45	6

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Engineering

2023-24 Program of Study	Year 1	Year 2	Year 3	Year 4
Engineering	Principles of Engineering & Technology (C21H04)	Engineering Design I (C21H05) -or- **IGCSE** Design & Technology (C21H03)	Engineering Design II (C21H06) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Engineering I (C21H00) -or- **Dual Enrollment** Engineering II (C21H11)	Engineering Practicum (C21H14) -or- **AP** Physics I: Algebra-Based (G03H27) -or- **AP** Physics II: Algebra-Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or- **AP** Physics C: Mechanics (G03H29) -or- **AP** Computer Science A (G02H45) -or- **Dual Enrollment** Engineering III (C21H41) -or- **Dual Enrollment** Engineering IV (C21H42) -or- **CIE** Design & Technology 1 AS Level

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				(C10H05) -or- **IB** Physics II (SL) (G03H82) -or- **WBL** Engineering Career Practicum (C21H47)

Description

Engineering is a POS designed for students interested in the various disciplines of engineering and engineering technology. Course content is arranged around four sequenced, progressive courses that provide students with the opportunity to develop critical thinking skills and an understanding of engineering concepts. Students then apply these skills with the multi-step engineering design processes to solve real-world problems. The capstone Engineering Practicum course places students with industry partners to complete a design project, report the results, and present their project before an audience.

This POS is aligned with SkillsUSA and TSA CTSOs.

Job Outlook

Engineers play a significant role in pushing the boundaries of applied science and solving technical problems that enable construction, manufacturing, medicine, and numerous other areas to reach new heights. The field is often at the leading edge of innovation and plays a significant role in shaping society and its future. According to the Bureau of Labor Statistics, overall employment of industrial engineers is strong both statewide and nationally. Nationally, industrial engineers are projected to grow 12 percent from 2022 to 2032, much faster than the average for all occupations[11]. Tennessee is expecting a 29 percent projected growth in employment of industrial engineers[12].

[11] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Industrial Engineers], at https://www.bls.gov/ooh/architecture-and-engineering/industrial-engineers.htm (Visited February 1, 2024)

[12] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

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There are about 22,800 openings for industrial engineers each year, on average, over the decade[13]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 1. Tennessee employment projections for Engineering-related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[14]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Industrial Engineers	17-2112	5,400	6,980	29%	540
General and Operations Managers	11-1021	46,121	56,274	22%	5,210
Computer Systems Analysts	15-1211	10,441	13,313	28%	1,103
Computer User Support Specialist	15-1232	10,264	13,245	29%	1,141
Management Analysts	13-1111	10,305	12,347	20%	1,220
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802
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Operating Engineers and Other Construction Equipment Operators	47-2073	6,754	7,834	16%	870
Network and Computer Systems Administrators	15-1244	5,250	6,247	19%	467
Industrial Production Managers	11-3051	4,662	5,451	17%	416

[13] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Industrial Engineers], at https://www.bls.gov/ooh/architecture-and-engineering/industrial-engineers.htm (Visited February 1, 2024)

[14] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

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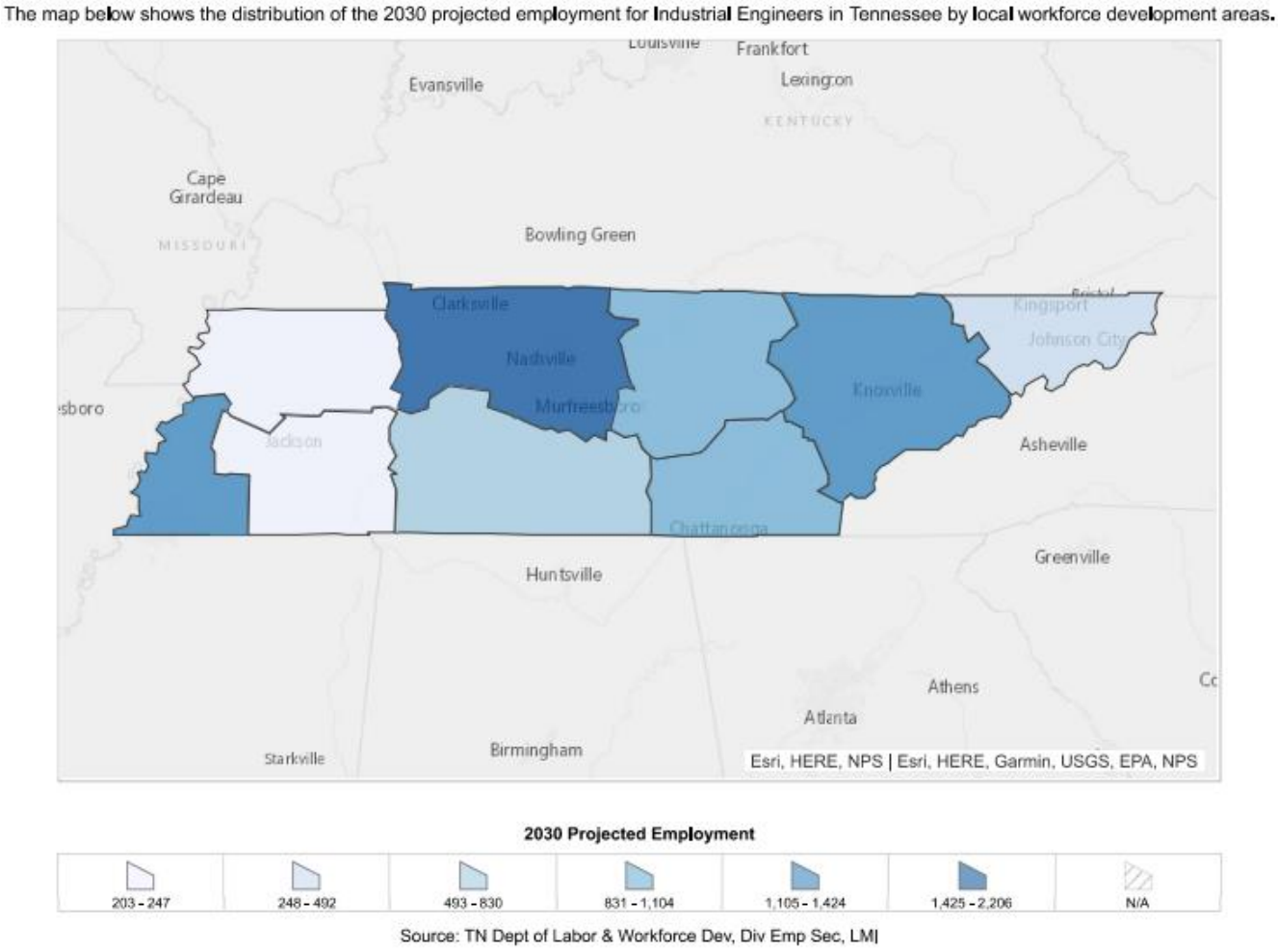
Figure 2. Tennessee employment projections for Industrial Engineering by region.[15]



Source: TN Dept of Labor & Workforce Dev, Div Emp Sec, LMI

[15] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

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Program of Study Level

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2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

Engineering: Level 3

Postsecondary Opportunities

In Tennessee, students aspiring to pursue engineering as a profession are presented with several post-secondary opportunities. The Tennessee College of Applied Technology (TCAT) offers specialized programs in engineering technology, providing hands-on training in areas such as mechanical, electrical, and civil engineering, equipping students with the practical skills necessary for entry-level positions in various engineering fields. Community colleges like Nashville State Community College and Pellissippi State Community College offer associate degree programs in engineering science or engineering technology, with coursework covering fundamental principles of engineering, mathematics, and computer-aided design (CAD), serving as a stepping-stone for further study or employment in the engineering sector.

Furthermore, universities such as the University of Tennessee at Knoxville and Tennessee Technological University offer bachelor's and advanced degree programs in various engineering disciplines, including mechanical, electrical, and chemical engineering, providing students with comprehensive theoretical knowledge and opportunities for hands-on research and internships. These institutions boast state-of-the-art facilities and renowned faculty members, positioning graduates for success in industries ranging from automotive and aerospace to energy and environmental engineering. With a diverse range of educational pathways tailored to different interests and career aspirations, Tennessee ensures that aspiring engineers have the resources and support they need to thrive in this dynamic and impactful profession.

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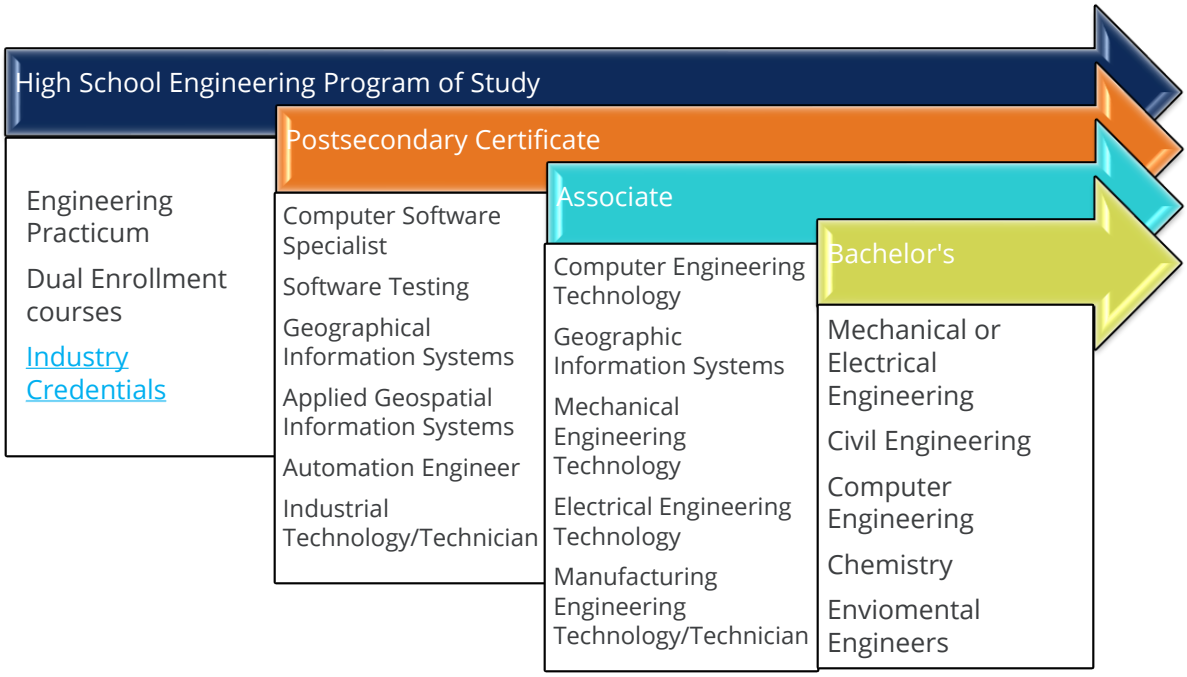

Additional opportunities are offered at multiple postsecondary institutions as indicated in the Tennessee Department of Labor and Workforce Dashboard.

High School Diploma	Certificate	Associate	Bachelor's
• N/A	• Electrical and Eletronic Engineering Technologist and Technicians **($58,560)**	• Electrical and Eletronic Engineering Technologist and Technicians **($58,560)**	• Electrical Engineer **($99,990)** • Environmental Engineer **($97,310)**

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Current Secondary Landscape

Over the past three years, the number of schools offering Engineering has increased from 51 to 59. In the 2022-23 school year, 7,963 students were enrolled in Engineering, which is a slight decrease from the previous year. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for 2020-21 through the 2022-23 school year and the enrollment in Engineering and student concentration in the STEM career cluster.

Figure 2. Open Enrollment Analysis

School Year	Schools Offering Engineering
2020-21	51
2021-22	63
2022-23	59

Figure 5. Student Enrollment by Course

School Year	Principles of Engineering and Technology	Engineering Design I	Engineering Design II	Engineering Practicum
2020-21	3,667	1,431	795	407
2021-22	4,795	1,929	1,026	470
2022-23	4,727	1,777	1,062	396

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Technology

2023-24 Program of Study	Year 1	Year 2	Year 3	Year 4
Technology	Principles of Engineering & Technology (C21H04)	Digital Electronics (C13H07)	Robotics & Automated Systems (C13H15) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Technology I (C21H01) -or- **Dual Enrollment** Technology II (C21H12)	Engineering Practicum (C21H14) -or- **AP** Physics I: Algebra-Based (G03H27) -or- **AP** Physics II: Algebra-Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or- **AP** Physics C: Mechanics (G03H29) -or- **AP** Computer Science A (G02H45) -or- **Dual Enrollment** Technology III (C21H43) -or- **Dual Enrollment** Technology IV (C21H44) -or- **IB** Physics II SL (G03H82) -or-

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				WBL Technology Career Practicum (C21H48)

Description

The *Technology* POS is for students who wish to pursue careers in robotics, electronics, and related engineering and technology fields. The course content introduces students to the principles of engineering and the engineering design process, then progresses to apply these skills in the context of robotics, electronics, and automated systems. Upon completion of this POS, students will have gained valuable training in an Engineering Practicum and will be prepared for advanced study in a variety of STEM fields at the postsecondary level.

This POS is aligned with SkillsUSA andTSA CTSOs.

Job Outlook

There is continuous work and progress in technology as it offers significant benefits, and these benefits have an enormous impact on our day-to-day lives and the operations of countless industries, such as healthcare, automobile, communication, manufacturing, and business, among others. According to the Bureau of Labor Statistics, the overall employment of industrial machinery mechanics, machinery maintenance workers, and millwrights is strong both statewide and nationally. Nationally, industrial machinery mechanics are projected to grow 13 percent from 2022 to 2032, much faster than the average for all occupations[16]. Tennessee is expecting a 38 percent projected growth in the employment of industrial machinery mechanics[17].

[16] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Industrial Machinery Mechanic, Machinery Maintenance Workers, and Millwrights], at https://www.bls.gov/ooh/installation-maintenance-and-repair/industrial-machinery-mechanics-and-maintenance-workers-and-millwrights.htm (Visited February 1, 2024)

[17] National Center for O*Net Development. O*NetOnLine. Retrieved February 1, 2024 from https://www.onetonline.org/

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There are about 19,200 openings for industrial machinery mechanics each year, on average, over the decade[18]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force, such as to retire.

Figure 1. Tennessee employment projections for Technology-related occupations with positive job openings projected for 2020-2030 according to the Tennessee Higher Education Commission, Supply and Demand Report.[19]

Occupation	SOC Code	Employment (2020)	Projected Employment (2030)	Projected Growth (2020-2030)	Projected Annual Job Openings (2020-2030)
Laborers and Freight, Stock, and Material Movers, Hand	53-7062	93,794	116,914	25%	16,089
General and Operations Managers	11-1021	46,121	56,264	22%	5,210
Maintenance and Repair Workers, General	49-9071	28,243	33,131	17%	3,360
Production Workers, All Other	51-9199	18,206	22,281	22%	2,597
First-line supervisors of Production and Operating Workers	51-1011	18,625	21,497	15%	2,239
Computer Systems Analysts	15-1211	10,441	13,313	28%	1,103
Computer User Support Specialists	15-1232	10,264	13,245	29%	1,141
Industrial Machinery Mechanics	49-9041	9,511	13,154	38%	1,324
Management Analysts	13-1111	10,305	12,347	20%	1,220
Computer and Information Systems Managers	11-3021	7,256	9,247	27%	802

[18] Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, [Industrial Machinery Mechanic, Machinery Maintenance Workers, and Millwrights], at https://www.bls.gov/ooh/installation-maintenance-and-repair/industrial-machinery-mechanics-and-maintenance-workers-and-millwrights.htm (Visited February 1, 2024)

[19] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 1, 2024, from https://www.tn.gov/thec/research/supply-and-demand.html

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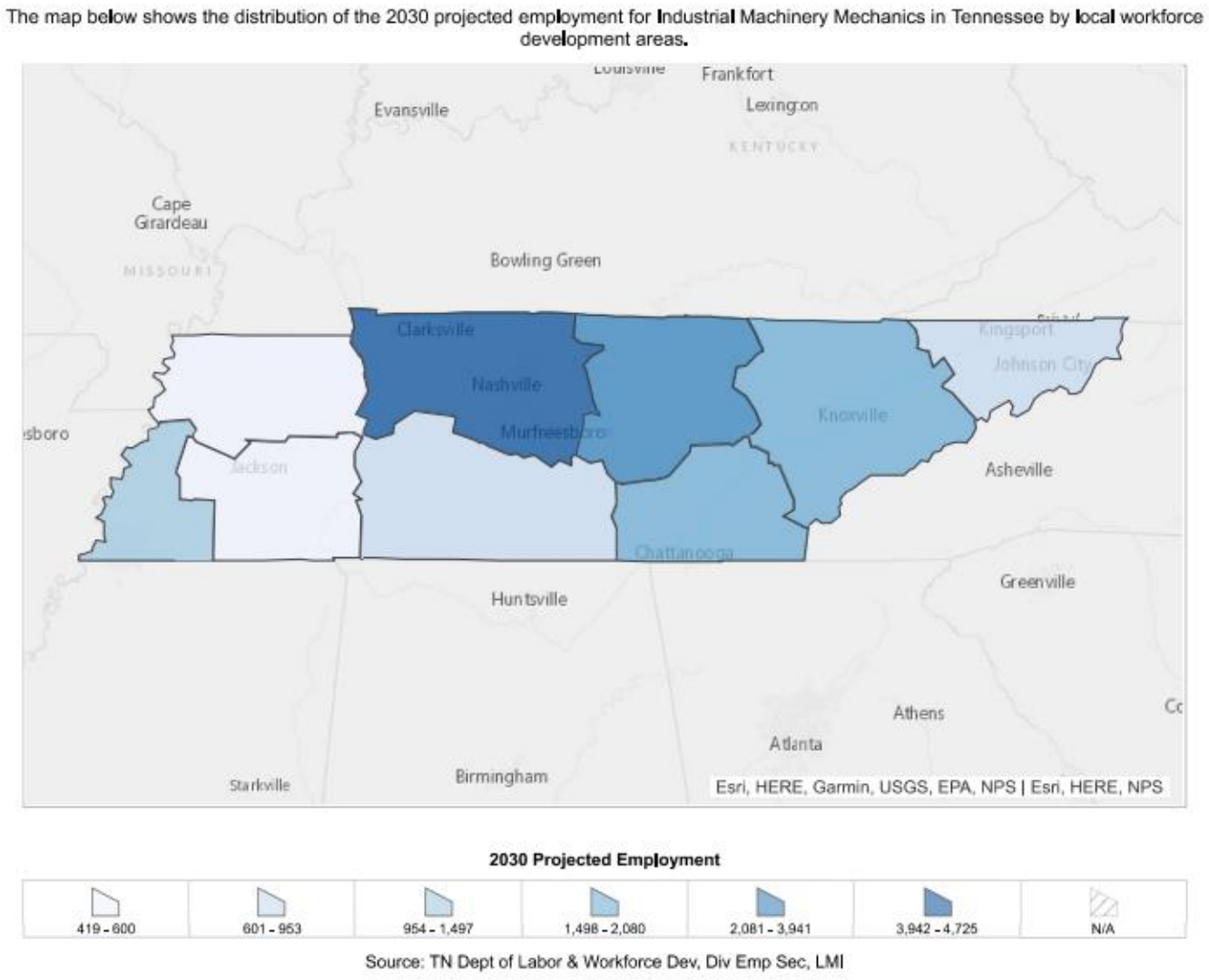
Figure 2. Tennessee employment projections for Technology-related occupations with positive job openings projected 2020-2030.[20]



[20] Jobs4Tn.gov. Occupation Profile. Retrieved (February 1, 2024), from https://jobs4tnwfs.tn.gov/vosnet/Default.aspx

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Program of Study Level

TISA provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student progression in coursework through the program

*The state budget keeps all programs funded at $5,000 for 2024-25 school year funding. See the CTE TISA Programs of Study Leveling Guide 2024-25 for the TISA funding formula for program of study levels.

Technology: Level 2

Postsecondary Opportunities

Tennessee offers a plethora of post-secondary opportunities for students eager to pursue careers in STEM technology fields. The Tennessee College of Applied Technology (TCAT) provides specialized programs in areas such as computer technology, engineering technology, and information systems, equipping students with hands-on training and certifications crucial for thriving in the technology sector. Additionally, community colleges like Nashville State Community College and Chattanooga State Community College offer associate degree programs in STEM-related fields such as computer science, engineering, and information technology, covering a wide range of foundational concepts and practical skills necessary for entry-level positions in the industry.

Furthermore, universities such as the University of Tennessee at Knoxville and Vanderbilt University offer bachelor's and advanced degree programs in various STEM disciplines, including computer engineering, biomedical engineering, and data science. These institutions provide opportunities for cutting-edge research, interdisciplinary collaboration, and industry partnerships, preparing graduates for leadership roles in fields such as artificial intelligence, cybersecurity, and renewable energy. With a diverse array of educational pathways tailored to different interests and career goals, Tennessee ensures that aspiring STEM technology professionals have the resources and support needed to excel in this dynamic and rapidly evolving field.

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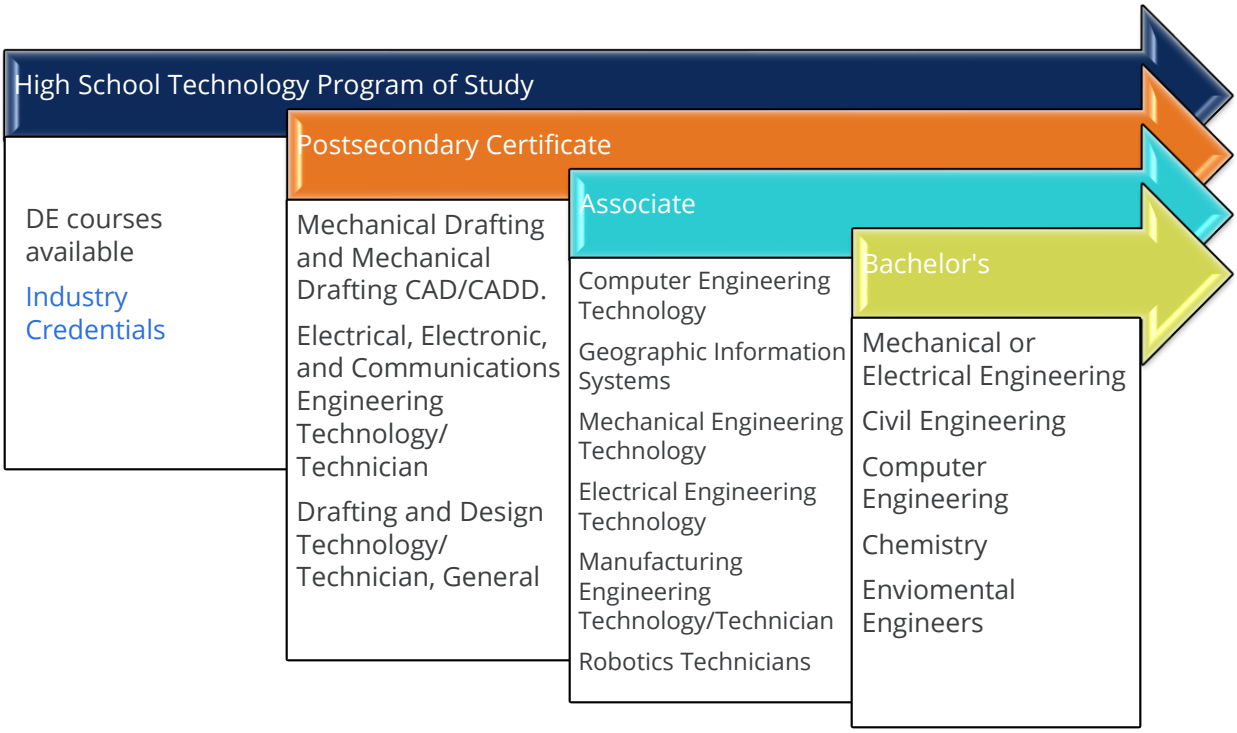
Figure 4. Outlines the related career opportunities and training necessary for each program of study. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions as indicated in the [Tennessee Department of Labor and Workforce Dashboard](#).

High School Diploma	Certificate	Associate	Bachelor's
• NA	• Electrical and Eletronic Engineering Technologist and Technicians **($58,560)**	• Electrical and Eletronic Engineering Technologist and Technicians **($58,560)** • Robotics Technicians **($44,870)**	• Mechanical Engineering **($93,650)** • Electrical Engineering **($99,990)**

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Current Secondary Landscape

Over the past three years, the number of schools offering Technology has remained the same at 36. In the 2022-23 school year, 6,519 students were enrolled, and 534 concentrated in Technology. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2020-21 through the 2022-23 school year as well as the enrollment and student concentration in the Technology program.

Figure 3. Open Enrollment Analysis

School Year	Schools Offering Technology
2020-21	36
2021-22	39
2022-23	36

Figure 5. Student Enrollment by Course

School Year	Principles of Engineering and Technology	Digital Electronics	Robotics & Automated Systems	Engineering Practicum
2020-21	3,668	845	951	407
2021-22	4,796	808	1062	470
2022-23	4,727	755	641	396

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Bureau of Labor Statistics, U.S. Department of Labor. (2024, March 11). *Occupation Outlook Handbook*. https://www.bls.gov/ooh/

National Center for O*NET Development. (2024, March 11). ONET Online*. https://www.onetonline.org/

Jobs4Tn.gov. (2024, March 11). *Occupation Data*. https://jobs4tnwfs.tn.gov/vosnet/analyzer/drill/drill.aspx?enc=e7AKr7bjUGRBEdrMte14UU/yogJNLO8Pv84AeQ47o7RHYdO6bz/6xZJrhpqcrleAp8cmiHwwVz7Rx4EEfPLwSw==

Tennessee Department of Labor & Workforce Development. (2024, March 11). *Tennessee's in demand occupations to 2026*. JOBS4TN.GOV. https://www.tn.gov/content/dam/tn/workforce/documents/jobs-and-education/InDemandOccupationsto2026.pdf

Tennessee Higher Education Commission. (2023). *Improving the pipeline for Tennessee's workforce: Academic supply for occupational demand report 2023*. Supply and Demand Report. 2023 Supply and Demand Report.pdf (tn.gov).

Recommendations

The following includes recommendations for course standards changes to be presented to the State Board of Education (SBE) for consideration in August 2024.

Program of Study	Course	Recommendations
Advanced STEM Applications	STEM I: Foundations	• Add a standard to highlight the importance and integration of CTSOs in the classroom. • Add a standard to emphasize the growing need for data analysis in all career areas. • Add a standard to point out the prominence of Artificial Intelligence.
BioSTEM	BioSTEM I	• Add a standard to highlight the importance and integration of CTSOs in the classroom. • Add a standard to emphasize the growing need for data analysis in all career areas.

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		• Add a standard to point out the prominence of Artificial Intelligence.
BioSTEM	BioSTEM II	Add a standard to highlight the importance of utilizing the engineering design process while working with a team to complete a project.
• Engineering • Technology	Principles of Engineering & Technology	• Add a standard to highlight the importance and integration of CTSOs in the classroom. • Add a standard to emphasize the growing need for data analysis in all career areas. • Add a standard to point out the prominence of Artificial Intelligence.
Technology	Digital Electronics	Add a standard to focus on data analysis.

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2025-26 Proposed Programs and Courses

Advanced STEM Applications

2025-26 Program of Study	Year1	Year 2	Year 3	Year 4
Advanced STEM Applications	STEM I: Foundation (C21H15)	STEM II: Applications (C21H16)	STEM III: STEM in Context (C21H17) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Advanced STEM Applications I (C21H32) -or- **Dual Enrollment** Advanced STEM Applications II (C21H33)	STEM IV: STEM Practicum (C21H18) -or- **AP** Calculus AB (G02H24) -or- **AP** Calculus BC (G02H25) -or- **AP** Computer Science A (G02H45) -or- **AP** Biology (G03H10) -or- **AP** Chemistry (G03H16) -or- **AP** Physics I: Algebra-Based (G03H27) -or- **AP** Physics II: Algebra-Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or- **AP**

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				Physics C: Mechanics (G03H29) -or- **Dual Enrollment** Advanced STEM Applications III (C21H35) -or- **Dual Enrollment** Advanced STEM Applications IV (C21H36) -or- **IB** Biology II SL/HL (G03H69) -or- **IB** Physics II SL (G03H82) -or- **WBL** Advanced STEM Applications Career Practicum (C21H45)

BioSTEM

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
BioSTEM	BioSTEM (C21H07)	BioSTEM II (C21H08)	BioSTEM III (C21H09) -or- **Dual Enrollment** BioSTEM I (C21H37) -or- **Dual Enrollment** BioSTEM II (C21H38)	BioSTEM Practicum (C21H10) -or- **Dual Enrollment** BioSTEM III (C21H39) -or- **Dual Enrollment** BioSTEM IV (C21H40) -or- **WBL**

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				BioSTEM Career Practicum (C21H46)

Engineering

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Engineering	Principles of Engineering & Technology (C21H04)	Engineering Design I (C21H05) -or- **IGCSE** Design & Technology (C21H03)	Engineering Design II (C21H06) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Engineering I (C21H00) -or- **Dual Enrollment** Engineering II (C21H11)	Engineering Practicum (C21H14) -or- **AP** Physics I: Algebra-Based (G03H27) -or- **AP** Physics II: Algebra-Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or- **AP** Physics C: Mechanics (G03H29) -or- **AP** Computer Science A (G02H45) -or- **Dual Enrollment**

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				Engineering III (C21H41) -or- **Dual Enrollment** Engineering IV (C21H42) -or- **CIE** Design & Technology 1 AS Level (C10H05) -or- **IB** Physics II (SL) (G03H82) -or- **WBL** Engineering Career Practicum (C21H47)

Technology

2025-26 Program of Study	Year 1	Year 2	Year 3	Year 4
Technology	Principles of Engineering & Technology (C21H04)	Digital Electronics (C13H07)	Robotics & Automated Systems (C13H15) -or- **AP** Computer Science Principles (G02H44) -or- **Dual Enrollment** Technology I (C21H01) -or- **Dual Enrollment** Technology II (C21H12)	Engineering Practicum (C21H14) -or- **AP** Physics I: Algebra- Based (G03H27) -or- **AP** Physics II: Algebra- Based (G03H28) -or- **AP** Physics C: Electricity & Magnetism (G03H24) -or-

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				AP Physics C: Mechanics (G03H29) -or- **AP** Computer Science A (G02H45) -or- **Dual Enrollment** Technology III (C21H43) -or- **Dual Enrollment** Technology IV (C21H44) -or- **IB** Physics II SL (G03H82) -or- **WBL** Technology Career Practicum (C21H48)

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