OREGON CAREER AND TECHNICAL EDUCATION STATEWIDE FRAMEWORKS

Information and Communication Technology Career Cluster

Resource Guide

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Well-designed career and technical education (CTE) programs help high school and college students make successful educational transitions and find employment in high-wage, high-skill, in-demand careers. **Oregon's State Plan for CTE: 2020-2024** lays out a comprehensive strategy for ensuring all Oregonians have equitable access to high-quality CTE programming. This entails designing instructional coursework that is sequenced within and across educational levels, grounded in rigorous academic knowledge and technical skills, and aligned with industry needs. It also requires creating quality relationships, experiences, and interactions among learners, educators, business partners, and community members.

> **OREGON'S VISION FOR CTE**
>
> **Reimagine and transform learner experiences to enhance their future prospects, empower communities, and ensure equitable access to an inclusive, sustainable, innovation-based economy.**

This document provides information and resources related to the ***Statewide Program of Study Framework in Information and Communication Technology,*** which falls within the Arts, Information and Communications learning area. Information and Communication Technology (ICT) is one of 17 Career Clusters used to organize and deliver CTE programming in Oregon. The ICT field includes a range of careers relating to the design, development, support, and management of computing hardware, software, and multimedia, along with systems integration services. The industry has had a revolutionary impact on the global economy and society, transforming the way businesses operate and people live.

Oregon's new CTE state plan calls for the development of Statewide Program of Study Frameworks to guide CTE program design. The goal is to *improve instructional quality* by aligning technical skills to the needs of employers in high-wage, high-skill, and in-demand careers; promote equity by ensuring that all learners have access to consistent high-quality programming; strengthen career pathways by intentionally connecting secondary and postsecondary coursework that culminates in an industry-recognized credential or certificate, or associate or baccalaureate degree; and *expand student access* to dual and concurrent enrollment credits to reduce tuition costs and the time required to earn a postsecondary credential.

While secondary and postsecondary CTE providers have considerable flexibility in designing curriculum and assessments, state approval is required to qualify programs for federal and/or state funding. This includes aligning offerings with labor market needs; meeting state-defined criteria for size, scope, and quality; addressing all of Oregon's five core elements of a Program of Study; and continuously improving CTE offerings through the use of the **Oregon CTE Program of Study Quality Rubric.**

Within Oregon, a CTE Program of Study is the primary vehicle for delivering coursework at the secondary and postsecondary levels. A CTE Program of Study is a progressive, nonduplicative sequence of courses, developed by a secondary school district and postsecondary institution partnering together, designed to prepare students to seamlessly transition across education levels and into the workforce. Coursework integrates rigorous academic knowledge with industry-validated employability and technical skills, culminating in the award of an industry-recognized credential or certificate, or an associate or baccalaureate degree. High school students may also have options to earn college credit that may be applied toward their postsecondary studies.

Within each Career Cluster, CTE Programs of Study may be offered at the Career Cluster or Focus Area level. Career Cluster Programs of Study offer students broad exposure to multiple careers in the field, along with cross-cutting skills valued by all industry employers. Focus Area Programs of Study offer students more occupationally specific training with a higher level of statewide content standardization.

The new Statewide CTE Frameworks provide updated Knowledge and Skill Statements to inform CTE program development. The updated Knowledge and Skill Statements incorporate: 1) employability skills commonly found in all jobs in all Career Clusters; 2) cross-cutting technical skills applicable to all jobs in a specific Career Cluster; and 3) Focus Area skills applicable to a specific job. Each Knowledge and Skill Statement includes an optional set of Suggested Performance Indicators, which are intended to help educators develop curriculum and assessments to teach specific skills.

Projected Labor Market Demand

Labor projections published by the State of Oregon Employment Department indicate that while the ICT field will expand over the coming decade, a subset of high-wage, high-skill occupations will experience significant demand. These are defined as those paying more than the statewide median wage or having more than the statewide median number of total job openings. These occupational titles, projected demand, and wage and educational expectations of entry-level employees are provided in Table 1.

Table 1. Projections for High-Wage and High-Demand Information Technology Occupations in Oregon, 2020-2030

Standard Occupational Classification (SOC)* code	Occupational title	Total job openings	Percent change 2020-2030	2020 median annual wage	Entry-level education
15-1211	Computer Systems Analysts	4,910	11.6%	$100,443	BA/BS
15-1212	Information Security Analysts	1,441	37.8%	$105,726	BA/BS

Standard Occupational Classification (SOC)* code	Occupational title	Total job openings	Percent change 2020-2030	2020 median annual wage	Entry-level education
15-1231	Computer Network Support Specialists	1,853	15.7%	$60,403	Certificate
15-1232	Computer User Support Specialists	7,088	13.5%	$57,221	Certificate
15-1241	Computer Network Architects	913	10.3%	$113,381	BA/VS
15-1244	Network and Computer Systems Administrators	3,628	11.4%	$88,421	BA/BS
15-1245	Database Administrators and Architects	1,262	16.1%	$103,501	BA/BS
15-1251	Computer Programmers	797	-6.5%	$86,528	BA/VS
15-1256	Software Developers and Quality Assurance Analysts and Testers	17,671	27.5%	$107,058	BA/VS
15-1257	Web Developers and Digital Interface Designers	2,374	16.6%	$78,229	BA/BS
15-1299	Computer Occupations, All Other	3,239	13.2%	$86,341	HS diploma

Note: Adapted from **State of Oregon Employment Department: High-Wage, High-Demand, and High-Skill Occupations (Projections 2020-2030)**

*SOC code = Standard Occupational Classification used to classify workers into job categories.

The largest growth in Oregon is projected for Software Developers and Quality Assurance Analysts and Testers, with demand expected to increase by 28 percent between 2020 and 2030. This will lead to 17,671 projected job openings, including new and replacement workers. Relatively large job openings are anticipated in several fields, including Computer User Support Specialists, Computer Systems Analysts, and Network and Computer Systems Administrators.

Jobs in ICT typically pay high wages. Median annual earnings in 2020 were approximately $107,058 for software developers, projected to have the largest number of job openings. Wages in other jobs fields range from $57,221 for Computer User Support Specialists to $113,381 for Computer Network Architects.

While many high-paying ICT careers require a four-year degree, learners may follow multiple pathways to career success. This can include entering the workforce with a high school diploma and basic computing skills, obtaining professional certifications offered by computer manufacturers (e.g., Oracle Certified Associate, Microsoft Certified Solutions Expert), or pursuing stackable credentials or an associate degree offered by an Oregon community college.

Statewide Program of Study Framework Options

The ICT Career Cluster is intended to prepare high school and college graduates for entry-level employment and/or advanced postsecondary studies. When designing programming, school district and community college CTE providers are required to collaborate to offer coursework leading to an industry-recognized credential or certificate and/or associate degree, including an Applied Associate of Science (AAS) degree or the Associate of Science Oregon Transfer (ASOT) degree in computer science. High school students also may be offered the opportunity to earn college credit that may be applied toward their certificate or degree objective. All ICT-related postsecondary certificates and degrees "stack" toward a Bachelor of Science degree offered by Oregon's public four-year colleges and universities.

In fall 2021 the Oregon Department of Education launched a statewide effort to update and revalidate the Knowledge and Skill Statements used to define the ICT Career Cluster. Previously, skill sets were based on the National Career Technical Core Standards published by Advance CTE in June 2012. The goal was to identify the employability and technical skills desired of entry-level workers. Work began with a review of labor market information compiled by the Oregon Employment Department to identify high-wage, high-skill, and in-demand occupations. An advisory group, comprised of Oregon employers and representatives of the Technology Association of Oregon, reviewed existing state skills and those of other states to create a new set of statements. A statewide survey of employers was then conducted to collect feedback on the proposed new set, with refinements made as needed.

Based on this work, two Focus Areas were identified as initial candidates for the Statewide Program of Study Framework: (1) Computer Programming and Coding, and (2) Information Technology, Networks, and Cybersecurity.
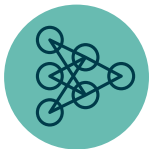
Knowledge and Skill Statements

Knowledge and Skill Statements describe the learning expectations of students in CTE programs. The Statewide Program of Study Framework for ICT is organized around three levels of skills (see Figure 1).

Employability Knowledge and Skills – Applicable to all Career Clusters

All learners are expected to possess a basic set of knowledge and skills that will prepare them to function in the workplace. These cross-cutting abilities, found in all jobs in all industries, encompass a broad range of communication, critical thinking, interpersonal, and organizational skills considered imperative for career success.

Career Cluster Knowledge and Skills – Applicable to all ICT careers

All workers in the ICT field are expected to have a broad understanding of the industry. These cross-cutting, Cluster-specific Skill Statements enable workers to succeed in a range of ICT jobs. High school students possessing these skills should be prepared to enter community college to pursue a range of occupationally specific training options that build on their secondary coursework.

Focus Area Knowledge and Skills – Applicable to a specific ICT career

Focus Area Skill Statements define field-specific knowledge that an entry-level worker would be expected to possess. High school students possessing these skills would be prepared to enter employment or enroll in a community college to pursue advanced training, ideally with credit that can be applied toward their college program. Postsecondary graduates would be prepared to enter employment with a credential, certificate, or degree in a high-wage, high-skill, in-demand field.

Detailed descriptions of the Knowledge and Skill Statements for new Statewide Program of Study Frameworks in (1) Computer Programming and Coding, and (2) Information Technology, Networks, and Cybersecurity are contained in Appendix A.

Each Knowledge and Skill Statement includes a list of Suggested Performance Indicators that illustrate how students might demonstrate their understanding or abilities relating to each statement (see Appendix A). These are examples intended to provide educators with guidance in establishing program content and assessments and designing curriculum and instructional activities. *These Suggested Performance Indicators are offered as optional, industry-suggested ways to demonstrate the Knowledge and Skill Statements. They are **not** required. Educators may choose to design other means for students to show mastery of the Knowledge and Skill Statements in their Program of Study.* It is anticipated that secondary and postsecondary educators will collaborate in selecting the number, type, and specificity of Suggested Performance Indicators, as well as the educational level at which they will be taught.

Figure 1. Knowledge and Skill Statements for the Statewide Program of Study Framework for Information and Communication Technology

INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAM OF STUDY KNOWLEDGE AND SKILL STATEMENTS

EMPLOYABILITY *Cross-cutting, same for all Career Clusters*	**CAREER CLUSTER** *All Cluster and Focus Area IT Program of Study*
• Workplace practices • Personal responsibility and accountability • Cultural competence • Teamwork and conflict resolution • Communication • Critical thinking • Creativity and innovation • Use of workplace technologies • Planning, organizing, and managing work • Career planning	• Collaboration of cross-functional teams • Computer languages and software development • Data science, visualization, and cloud computing • Network communication and organization • Security threats and protection strategies • Backup and restore procedures • User and customer supports • Trends in emerging and evolving technology • Industry accepted ethical practices

FOCUS AREAS

Computer Programmers and Software Developers	*Computer Networks and Cybersecurity*
• Computer languages and software development • Build, test, and deploy code • Software development in the cloud • Communicate coding concepts • Privacy and security concepts	• Describe, use and troubleshoot hardware • Configure, manage, install and maintain client machines • Networking basics • Security best practices and implementation

Program of Study Design Options

Educators have two options in designing a Program of Study using a Statewide Program of Study Framework. They can pursue a Career Cluster Program of Study or a Focus Area Program of Study. The distinction between a Cluster and Focus Area Program of Study relates to the scope of Knowledge and Skill Statements covered in the Program of Study and to the level of secondary to postsecondary alignment (nonduplicative sequence of courses leading to a certificate or degree).

There are two primary distinctions between the two options:

1. **Career Cluster Programs of Study** are required to cover employability skills and Cluster skills; they may draw from Focus Area skills but are not required to do so.

2. **Focus Area Programs of Study** are more occupationally specific with a higher level of content standardization. Focus Area Programs of Study are required to cover *all skill sets in the Program of Study at the Employability, Career Cluster, and Focus Area levels.*

Educators may choose to offer a Career Cluster Program of Study and/or Focus Area Program of Study. The options are not mutually exclusive. Providers with existing, well-developed ICT Programs of Study may already fulfill many of the criteria of a Statewide Program of Study Framework; others may build toward fulfillment of the Statewide Program of Study Framework over time.

Career Cluster Program of Study Option

A Career Cluster Program of Study provides high school students with a broad overview of the technology field to prepare them to specialize in an area of their choosing at the postsecondary level. With this option, educators may choose to offer a broad range of courses that address different aspects of the ICT field, such as programming, networking, cybersecurity, web development, and gaming.

While educators have flexibility in designing program coursework, it is expected that all Career Cluster Programs of Study will address all the Employability and Cluster Knowledge and Skill Statements identified by employers (see Figure 1). Educators will continue to have the option of either selecting Knowledge and Skill Statements contained within the ICT Focus Areas used in past years, or incorporating those contained in the newly developed Focus Areas of (1) Computer Programming and Coding, and (2) Information Technology, Networks, and Cybersecurity.

To qualify as a concentrator at the Career Cluster level, high school students must complete at least two credits in a single Program of Study, with one of these credits earned through a course or courses identified as intermediate or advanced. High school graduates concentrating their studies in the ICT Career Cluster would have the option of continuing their studies at an affiliated community college, where they could pursue training (in one or more fields) that culminates in the award of a credential, certificate, or associate degree.

Focus Area Program of Study Option

Focus Area Programs of Study are intended to align with specific certificate and associate degree options offered at the postsecondary level. Where appropriate, districts and colleges can negotiate dual credit agreements so that high school students can earn college credit that may be applied toward a postsecondary certificate or degree, expediting the time it takes to complete.

The new Statewide Program of Study Framework option requires:

- Offering a minimum of three credits at the secondary level and 36 credits at the postsecondary level.
- Covering all the appropriate Knowledge and Skill Statements.
- Requiring concentrators to complete two credits in the Program of Study, including at least one intermediate- or advanced-level course.
- Providing a sequenced, progressive set of courses, including intro/survey, intermediate, and advanced.

- Exhibiting secondary-postsecondary alignment that is clearly defined and communicated to all stakeholders.
- Offering or potentially offering dual credit opportunities.
- Integrating career-related learning experiences, career connected learning, and work-based learning in meaningful ways.

High school graduates concentrating their studies in an ICT statewide program would have the option of continuing their studies at an affiliated community college, where they could seek advanced training in the Focus Area or pursue training in another ICT field that culminates in the award of a credential, certificate, or associate degree.

Statewide Program of Study Frameworks align course content to industry-validated skills so that students throughout the state have access to consistent, high-quality CTE with opportunities to gain college credit and skills in high-wage, high-skill, and in demand occupations.

Course Scope and Sequence

Regardless of whether a district seeks approval for a Career Cluster or Focus Area Program of Study, it is anticipated that CTE students will begin their course sequence with an introductory/survey course that opens a range of intermediate and advanced course options. An example of how an ICT Program of Study might be configured is provided in Table 2. *Note that course sequences and titles are provided for illustrative purposes only—it is up to secondary and postsecondary partners to determine course titles and sequences; course content, curriculum, and assessments, including when and how Knowledge and Skill Statements are addressed; and whether dual credit or industry certifications may be awarded.*

Table 2. Proposed Scope and Sequence in Information and Communication Technology

Level 1: Introductory (grades 9-10)	Level 2: Intermediate (grades 10-12)	Level 3: Advanced (grades 11-12)	Level 4: Advanced (grades 11-12)
Computer Science Foundations (survey course)	Computer Programming I	Computer Programming II	Computer Programming Practicum or Dual Credit Enrollment
	Networking and Cybersecurity I	Networking and Cybersecurity II	Networking and Cybersecurity Practicum or Dual Credit Enrollment
	Web Design I	Web Design II	Web Design Practicum or Dual Credit Enrollment

Note: Course sequence highlighted in gray indicates Focus Area Program of Study.

Additionally, all Programs of Study are expected to integrate a full range of **Career Connected Learning Experiences** that advance progressively, as indicated in Table 3.

Table 3. Career Connected Learning Experiences

Career Awareness: Learning about work	Career Exploration: Learning for work	Career Preparation: Learning through work	Career Training: Learning at work
Build awareness of the variety of careers available and the role of postsecondary education • Workplace tour • Guest speaker • Career fair • Visiting adults at work	*Explore career options to motivate students and inform their decision making* • Informational interview • Job shadow • Virtual interactions • Service learning (one-time)	*Apply learning through practical experience that develops knowledge and skills necessary for success in careers and postsecondary education* • Student-run enterprise • Virtual and simulated work experience • Internships • Work experience	*Train for employment and/or postsecondary education in a specific range of occupations* • Internships • Registered apprenticeship • Clinical and work experience • On-the-job training

Developing a CTE Program of Study for State Approval

To meet Oregon's definition of a High-Quality Program of Study, a CTE Program of Study must be built around five core elements. These elements and supporting components, which align to the Association for Career and Technical Education's (ACTE's) High-Quality CTE Program of Study Framework, are detailed in Table 4.

Table 4. Elements and Supporting Components of a High-Quality CTE Program of Study

Element	Components
Content	*Rigorous Integrated Content:* Appropriately licensed secondary teachers and postsecondary instructors integrate rigorous technical and academic content.
	Engaged Learning: Students are engaged through instructional strategies that are relevant and authentic, and meet the needs and interests of all students.
	Coherent Curriculum: Aligned to industry-identified standards and sequenced to prepare students for their next steps.
Alignment and Articulation	*Partnerships:* Actively engages employer and educator partners to develop, enhance and support the CTE program in a manner that is sustainable.
	Credentials: Links instruction to meaningful college credit or industry credentials that can lead to high-wage, high-skill, and in demand occupations.
	Facilities and Equipment: Provides students with safe access to facilities and equipment appropriate to the type of instruction and reflective of workforce needs.
Accountability and Evaluation	*Continuous Improvement:* Revisions to the Program of Study are based on student performance, economic demand, and employer requirements.
Student Support Services	*Equity and Access:* Provides all students and their families with appropriate knowledge and experiences to help make informed education and career decisions.
	Career Connected Learning: Provides quality, accurate and timely information and support that will help students identify, pursue, transition to, and complete pathways to future careers. Career Connected Learning should include activities and opportunities within the four domains of Awareness, Exploration, Preparation and Training.
Professional Development	*Professional Development:* Promotes instructional long-term growth that aligns with long-term program goals.

Educators are encouraged to consult the **Oregon CTE Program of Study Quality Rubric** and accompanying **Quick Guide for Using the High Quality CTE Program of Study (HQ POS) Rubric** to assess their existing CTE Programs of Study and create goals for continuous improvement.

CTE Licensure Requirements. Information and Communication Technology

Educators seeking to teach in the ITC Career Cluster area must possess a valid Oregon CTE endorsement in the appropriate Arts, Information and Communications learning area. See **CTE Licensure in Oregon** for an overview of licensing requirements and the steps to be taken to receive an endorsement. Contact Margaret Mahoney (**Margaret.Mahoney@ode.state.or.us**) for more information.

Career and Technical Student Organizations

Learning is enhanced when students can apply academic, technical, and employability skills in an authentic setting. Career and Technical Student Organizations (CTSOs) are extracurricular groups that offer youth the ability to practice and enhance their classroom learning, while developing personal skills and leadership abilities, through participation in activities, events, and competitions.

In the Information and Communication Technology field, there are two active CTSOs in Oregon:

Skills USA (https://www.skillsusa.org/) is an industrial and engineering CTSO preparing student learners for careers in trade, technical and skilled service occupations. Students participating in Information and Communication Technology learn about entry-level, technical, and professional careers in a range of fields, including computer programming, cybersecurity, Information Technology and networking.

Technology Student Association (https://oregontsa.org/) supports students in the Science, Technology, Engineering, and Mathematics (STEM) career fields. Members develop personal and leadership skills, and build career options though participation in a range of activities and programs. TSA sponsors seven national high school Computer Science and Information Technology competitions annually.

Appendix A. Knowledge and Skill Statements – Information and Communication Technology Statewide Program of Study Framework

Overview

The Arts, Information and Communications career learning area is comprised of two Career Clusters, which include 1) Arts, AV Technology and Communications, and 2) Information and Communication Technology.

This document details the Knowledge and Skill Statements comprising the Program of Study for the Information and Communication Technology Career Cluster. These statements, developed with input from business and industry practitioner groups, define the career readiness expectations of entry-level workers.

Each Knowledge and Skill Statement (indicated in bold) includes a list of Suggested Performance Indicators that illustrate how students might demonstrate their understanding or abilities relating to each statement. These indicators are intended to provide educators with guidance in establishing program content and assessments and designing curriculum and instructional activities. These Suggested Performance Indicators are offered as options—not requirements—for addressing the Knowledge and Skill Statements comprising a Program of Study. It is anticipated that secondary and postsecondary educators will collaborate in selecting the number, type, and specificity of Suggested Performance Indicators, as well as the educational level at which they will be taught.

The Program of Study for the Information and Communication Technology Career Cluster is intended to prepare students to successfully transition into postsecondary education or secure gainful employment in a related career field. Labor market projections for Oregon indicate that there is strong demand for a subset of high-wage, high-skill, in-demand occupations that fall within the Cluster area. Accordingly, the Program of Study includes Knowledge and Skill Statements (and associated Suggested Performance Indicators) for two Focus Areas: 1) Computer Programming and Coding, and 2) Information Technology, Networks, and Cybersecurity.

While each Focus Area is occupationally specific, the statements provided are primarily intended to address process issues, rather than specific hardware or software. For example, educators offering a Focus Area in computer programming and software development might teach elements of writing maintainable code (e.g., creating comments) that are relevant across programming languages. The intent is that students learn fundamental principles of the field, with the understanding that the curricular resources used to teach concepts will vary based on state, regional, or local economic conditions; instructor training or licensing; and/or district and college instructional resources.

Information and Communication Technology Knowledge and Skill Statements

Employability Knowledge and Skill Statements

Applicable to all Career Clusters in the Statewide Program of Study Framework.

E-01	Adhere to workplace practices
E-02	Exhibit personal responsibility and accountability
E-03	Practice cultural competence
E-04	Demonstrate teamwork and conflict resolution
E-05	Communicate clearly and effectively
E-06	Employ critical thinking to solve problems
E-07	Demonstrate creativity and innovative thinking
E-08	Demonstrate fluency in workplace technologies
E-09	Plan, organize, and manage work
E-10	Make informed career decisions

Cluster Level Knowledge and Skill Statements

Applicable to all Programs of Study in the Information and Communication Technology Statewide Program of Study Framework.

CC-IT01	Describe how cross-functional teams collaborate to achieve project goals
CC-IT02	Demonstrate understanding of computer languages and software development processes
CC-IT03	Demonstrate knowledge of data science, virtualization, and cloud computing
CC-IT04	Demonstrate understanding of network communication and organization
CC-IT05	Demonstrate awareness of security threats and protection strategies
CC-IT06	Perform standard computer backup and restore procedures to protect information
CC-IT07	Demonstrate a basic understanding of user and customer supports
CC-IT08	Describe trends in emerging and evolving technologies and their influence
CC-IT09	Describe and demonstrate industry accepted ethical practices and behavior

Focus Area Level Knowledge and Skills

Knowledge and Skill Statements for the updated Statewide Program of Study Framework in *(1) Computer Programming and Coding and (2) Information Technology, Networks, and Cybersecurity.*

Computer Programming and Coding

FA-ITCP01	Demonstrate ability to describe, use, and troubleshoot various IT hardware Infrastructure
FA-ITCP02	Demonstrate an ability to build, test, and deploy code leading to a basic understanding of Unix commands and environment setup
FA-ITCP03	Demonstrate an understanding of basic software development in the cloud
FA-ITCP04	Demonstrate ability to effectively communicate coding concepts
FA-ITCP05	Demonstrate understanding of privacy and security concepts in computing situations

Information Technology, Networks, and Cybersecurity

FA-ITNC01	Demonstrate ability to describe, use, and troubleshoot various IT hardware Infrastructure
FA-ITNC02	Demonstrate ability to configure, manage, install, and maintain client machines in a common IT environment
FA-ITNC03	Demonstrate a functional understanding of networking basics
FA-ITNC04	Articulate basic security best practices and discuss their real-world implementation in an enterprise environment

Employability Knowledge and Skill Statements with Suggested Performance Indicators

E-01	**Adhere to workplace practices**
Suggested Performance Indicators	A. Explain and follow workplace standards, rules, and regulations B. Show up on time and prepared to work C. Demonstrate the ability to take direction, be proactive, and work independently
E-02	**Exhibit personal responsibility and accountability**
Suggested Performance Indicators	A. Apply professional and ethical standards of the industry to personal conduct B. Maintain integrity and promote personal and professional integrity in co-workers C. Take responsibility and carry out work assignments
E-03	**Practice cultural competence**
Suggested Performance Indicators	A. Demonstrate awareness of issues related to diversity, equity, and inclusion B. Work effectively with colleagues of differing abilities, cultures, and backgrounds C. Describe issues relating to workplace harassment D. Model behaviors that are respectful and sensitive of others
E-04	**Demonstrate teamwork and conflict resolution**
Suggested Performance Indicators	A. Demonstrate the ability to collaborate and contribute to the work of a diverse team B. Explain when it is appropriate to lead and when to follow another's lead C. Demonstrate strategies for resolving issues with coworkers
E-05	**Communicate clearly and effectively**
Suggested Performance Indicators	A. Listen attentively, and speak and write clearly to convey information correctly B. Interpret information and instructions presented in verbal and written form C. Demonstrate effective communication with colleagues, supervisors, customers, and suppliers D. Demonstrate the ability to communicate verbally, in writing, and using electronic communication tools
E-06	**Employ critical thinking to solve problems**
Suggested Performance Indicators	A. Recognize problems in the workplace and diagnose their root causes B. Develop well-reasoned plans to solve identified challenges C. Apply and follow through on plans to ensure that problems are resolved

E-07	**Demonstrate creativity and innovative thinking**
Suggested Performance Indicators	A. Develop ideas to solve problems in new and different ways
	B. Investigate one's own and others' ideas to find those with greatest applicability
	C. Develop and deploy plans to implement new ideas in the workplace
E-08	**Demonstrate fluency in workplace technologies**
Suggested Performance Indicators	A. Demonstrate knowledge and application of general technology skills, including hardware and software commonly used in the industry
	B. Use online communication, networking tools and social networks to access, manage, evaluate, and create information to successfully function in a knowledge economy
	C. Describe and demonstrate a fundamental understanding of the ethical, legal, and security issues surrounding access to and use of information technologies
E-09	**Plan, organize, and manage work**
Suggested Performance Indicators	A. Identify an intended project outcome including available inputs, materials, labor, timeline for producing work, and job-site obligations
	B. Effectively plan, monitor, and complete projects on time and within budget using available resources and materials
	C. Demonstrate ability to write coherent reports and project summaries to communicate the progress of project work and its adherence to schedule
E-10	**Make informed career decisions**
Suggested Performance Indicators	A. Identify job and entrepreneurial opportunities in the industry and the required education and credentials to obtain employment
	B. Set short- and long-term career goals based on personal interests and aptitudes
	C. Maintain a project portfolio
	D. Develop a professional resume
	E. Explain and demonstrate how to cultivate and maintain a professional presence in an online environment, including the appropriate use of social media and networking platforms

Information and Communication Technology Career Cluster Knowledge and Skill Statements with Suggested Performance Indicators

CC-IT01	Describe how cross-functional teams collaborate to achieve project goals
Suggested Performance Indicators	A. Summarize the importance of cross-functional teams in achieving project goals B. Identify desired group and team behavior C. Describe the roles and responsibilities of team members typically engaged in implementing hardware and/or software technology solutions D. Describe strategies for maximizing productivity in a high-tech environment
CC-IT02	Demonstrate understanding of computer languages and software development processes
Suggested Performance Indicators	A. Explain why various computer languages exist B. Describe computer languages used to build desktop, server, mobile, and web applications C. Explain how programmers use various languages to solve problems D. Explain the processes involved in designing, writing, testing, and maintaining source code of computer programs to manage and maintain software E. Describe the software development life cycle F. Demonstrate knowledge of current coding languages and software development trends
CC-IT03	Demonstrate knowledge of data science, virtualization, and cloud computing
Suggested Performance Indicators	A. Describe the features, benefits, and concepts of virtualization and cloud computing B. Describe the characteristics and pros and cons of types of cloud services C. Demonstrate how to maintain and use databases D. Demonstrate ability to design data collection systems and implement strategies that maximize data quality E. Describe data analytics, how it is performed and also impacted by Big Data and related technologies
CC-IT04	Demonstrate understanding of network communication and organization
Suggested Performance Indicators	A. Explain the functionality of common networking protocols B. Explain the purpose of routing, network configuration, and monitoring C. Explain how to use hardware and software to facilitate communication between people and computer systems D. Explain the pros and cons of and recommend various types of network components to address industry needs E. Describe the purpose and function of fundamental end-user devices such as switches, routers, wireless access points

CC-IT05	**Demonstrate awareness of security threats and protection strategies**
Suggested Performance Indicators	A. Describe potential security threats to networked information systems
	B. Describe the standards and applications needed to protect the confidentiality, integrity, and availability of information and information systems
	C. Describe and demonstrate strategies to assess and protect against security threats (e.g., firewalls, user authentication, passwords, and restricted access)
	D. Demonstrate procedures to contain and remove viruses and malware

CC-IT06	**Perform standard computer backup and restore procedures to protect information**
Suggested Performance Indicators	A. Explain the need for regular backup procedures
	B. Configure, perform, and maintain backup procedures
	C. Describe and demonstrate the use of surge suppression protection tools
	D. Identify and describe batter backup equipment and its uses
	E. Demonstrate ability to select and employ commonly used platforms, technology, and tools

CC-IT07	**Demonstrate a basic understanding of user and customer supports**
Suggested Performance Indicators	A. Describe the type of services used to provide assistance and technical support to users
	B. Help users implement and solve problems related to information technology
	C. Demonstrate ability to assist customers in implementing and solving problems in a professional manner

CC-IT08	**Describe trends in emerging and evolving technologies and their influence**
Suggested Performance Indicators	A. Identify new information technologies (e.g., AI, IoT) and their social impacts
	B. Assess the importance of new technologies (e.g., Internet of Things - IoT) to future development, productivity, and knowledge
	C. Identify new and emerging drivers and inhibitors of information technology change
	D. Assess the potential importance and impact of new IT technologies in the future
	E. Describe how varying types of computer systems are used in business/industry/ government and other institutions and impact people's workday
	F. Describe the impact of computers on career pathways in business/industry (e.g., how computers have eliminated and created jobs)
	G. Describe the impact of computers on access to information and information exchange worldwide

CC-IT09	**Describe and demonstrate industry accepted ethical practices and behavior**
Suggested Performance Indicators	A. Describe legal issues faced by IT professionals
	B. Describe legal issues associated with a company security policy
	C. Summarize the rights and responsibilities of IT workers
	D. Demonstrate knowledge of ethical issues that have surfaced in the information age

Computer Programming and Coding Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ITCP01	**Demonstrate capability to implement foundational computer programming concepts**
Suggested Performance Indicators	A. Implement conditionals B. Implement loops C. Implement variable scope D. Implement algorithms and complexity E. Demonstrate knowledge of Common Data Structures F. Implement Software and Application Architecture Paradigms (ex. web/app/DB) G. Implement Object-Oriented Programming (OOP) H. Understand and utilize abstractions
FA-ITCP02	**Demonstrate an ability to build, test, and deploy code leading to a basic understanding of Unix commands and environment setup**
Suggested Performance Indicators	A. Demonstrate capability to build software using modern tooling B. Demonstrate working knowledge of the different types of testing (e.g., unit, functional, performance, security, etc.) C. Use multiple debugging/troubleshooting strategies D. Demonstrate capability to deploy tested code E. Demonstrate working knowledge of Error Handling F. Setup Unix-based machine) G. Setup source control like Git H. Setup developer tools and library dependencies I. Demonstrate basic knowledge of common Unix commands like grep, awk, sed
FA-ITCP03	**Demonstrate an understanding of basic software development in the cloud**
Suggested Performance Indicators	A. Demonstrate ability to use an API B. Describe the features, benefits, and concepts behind various application architectures (e.g., serverless, microservices, IaaS vs PaaS, High Availability [HA], etc.) C. Demonstrate basics of cloud monitoring (e.g., AWS Cloudwatch, GCP Operations Suite, etc.)
FA-ITCP04	**Demonstrate ability to effectively communicate coding concepts**
Suggested Performance Indicators	A. Write pseudocode and construct a flowchart for a process before starting to develop the program code B. Write maintainable code (code comments, external documentation, clarity of code, identifying code smells) B. Articulate the nature of program designs and why that design was chosen

FA-ITCP05	**Demonstrate understanding of privacy and security concepts in computing situations**
Suggested Performance Indicators	A. Exhibit proper handling of private and confidential data
	B. Demonstrate awareness of basic security concepts/practices
	C. Explain concepts involved in IT security technologies, including cyber terrorism and its countermeasures, and various auditing and monitoring tools and techniques
	D. Recognize and draw attention to potential IT security threats and risks, including common attacks, vulnerabilities, and methods used to compromise a system

Information Technology, Networks, and Cyber Security Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ITNC01	**Demonstrate ability to describe, use, and troubleshoot various IT hardware infrastructure**
Suggested Performance Indicators	A. Identify and troubleshoot the major hardware components unique to mobile devices
	B. Configure both the hardware and software unique to mobile devices to ensure best use for a typical end-user
	C. Summarize the major elements of a network, including its hardware components and underlying protocols
	D. Classify and compare different basic networking configurations and implementations
	E. Use appropriate networking tools to accomplish or troubleshoot a given situation
	F. Identify various hardware components and understand their use within a given system
	G. Properly install and troubleshoot desktop hardware and validate that installation
	H. Identify, configure, and install peripheral technologies often found in a typical Small Office / Home Office (SOHO) environment
	I. Explain the core philosophy of virtualization and cloud computing and show this by explaining its infrastructure and cost impacts to traditional computing
	J. Set up and configure client-side virtualization given a particular scenario
FA-ITNC02	**Demonstrate ability to configure, manage, install, and maintain client machines in a common IT environment**
Suggested Performance Indicators	A. Perform basic system administration tasks such as OS installation, network configuration, storage management, troubleshooting, and other basic sysadmin tasks
	B. Competently engage with systems by using their basic tools and operating system environment for daily tasks
	C. Summarize the key concepts of and perform basic actions in relation to information security as it applies to a SOHO environment including account security, antimalware installation, familiarity with basic OS-level security tools, and basic security for mobile devices
	D. Perform basic troubleshooting methodologies to resolve simple or common software-related issues, such as security issues, malware removal, mobile syncing, and general OS-level problems
	E. Identify various operational policies and procedures that commonly pertain to an IT environment and articulate their importance, such as change management concepts, disaster recovery, privacy, and licensing

FA-ITNC03	**Demonstrate a functional understanding of networking basics**
Suggested Performance Indicators	A. Identify basic networking ports and protocols, network topologies, and logical routing infrastructure and explain how these concepts interrelate
	B. Identify the basic concepts and characteristics of routing and switching technologies and infrastructure
	C. Distinguish the unique differences of wireless infrastructure and categorize and identify the basic components of that infrastructure
	D. Identify and manipulate the essential physical networking infrastructure found in common network deployments (this includes the devices as well as the connection media)
	E. Identify and categorize essential networking infrastructure and demonstrate functional understanding of each individual node as well as how they impact the greater network
	F. Explain and draft the basic documentation often found in developing and maintaining a network (this includes network topologies and disaster recovery planning, as well as policies and best practices)
	G. Identify and configure the unique tools and infrastructure that can be deployed to best protect a network
	H. Demonstrate a functional understanding of the common attacks that can be leveraged against the network as well as the mitigations that can be put into place to stop them
	I. Use a well-developed troubleshooting methodology to troubleshoot common wired and wireless connectivity issues often found in a network
	J. Identify common networking tools and functions and explain how they can be used in the initial creation of the network and in troubleshooting or maintaining it

FA-ITNC04	**Articulate basic security best practices and discuss their real-world implementation in an enterprise environment**
Suggested Performance Indicators	A. Classify various attack, malware, and exploitation types commonly found in contemporary cyber-attacks and take steps to redress safety/security hazards in an enterprise environment
	B. Identify various threat actors as well as common vulnerabilities
	C. Explain the importance of designing good security practices by considering the unique challenges and context of an enterprise environment
	D. Articulate basic workflows, concepts, tools, and best practices associated with incident response
	E. Articulate secure application and coding development practices
	F. Summarize the techniques and approaches that are used in security assessments and penetration tests
	G. Identify key best practices and policies often used when implementing and auditing compliance and governance frameworks and describe NIST CSF and RMF
	H. Summarize risk management processes and concepts
	I. Given a scenario, identify and implement security configurations or changes to applications, hosts, networks, mobile devices, and cloud environments
	J. Articulate the importance of governance, risk, and compliance to daily security tasks and the field of information security as a whole
	K. Summarize the basics of cryptographic concepts often found in enterprise security environments
	L. Explain the key concepts of digital forensics usually associated with an enterprise environment