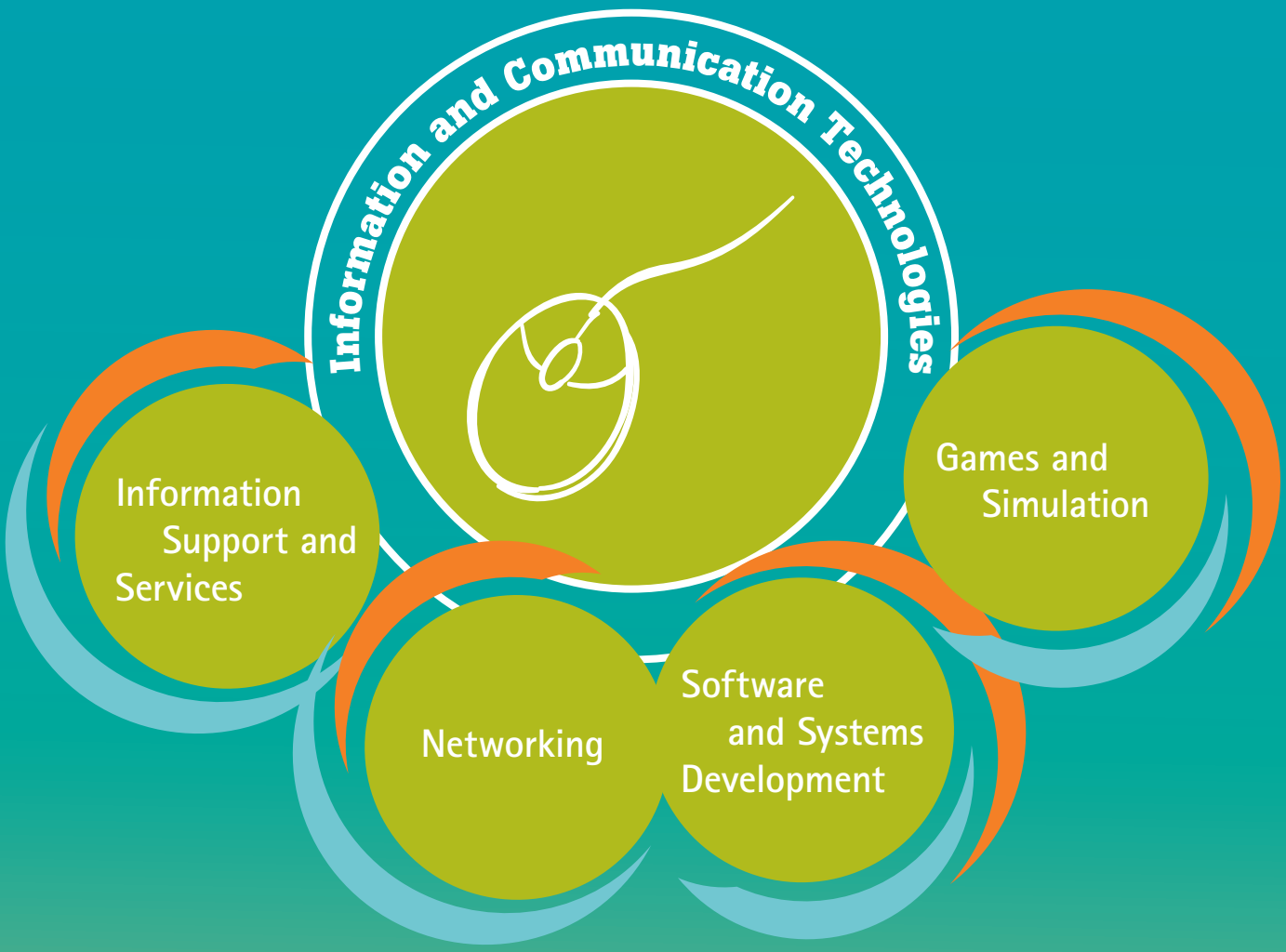
Information and Communication Technologies
Information Support and Services
Games and Simulation
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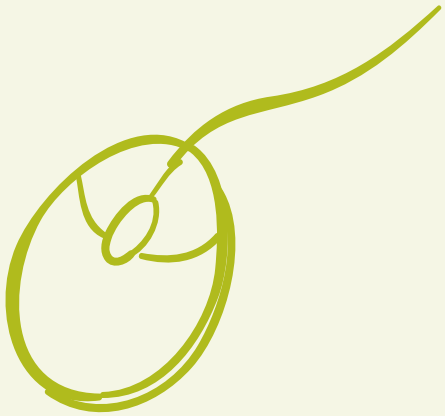
Information and Communication Technologies

Sector Description

Information and Communication Technologies (ICT) have expanded the need for employees who can understand, manage, and support all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, and information systems. Essential skills for careers in the ICT sector include understanding systems that support the management and flow of data, the ability to work well and communicate clearly with people, and the ability to manage projects efficiently. The ICT sector meets national criteria for high demand, high wages, and high skills and provides students with excellent opportunities for interesting work and good pay. More than 70 percent of jobs in this sector will require a bachelor's degree or higher by 2018.



1.0 Academics

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Information and Communication Technologies academic alignment matrix for identification of standards.

2.0 Communications

Acquire and accurately use Information and Communication Technologies sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats. (Direct alignment with LS 9-10, 11-12.6)

2.1 Recognize the elements of communication using a sender–receiver model.

2.2 Identify barriers to accurate and appropriate communication.

2.3 Interpret verbal and nonverbal communications and respond appropriately.

2.4 Demonstrate elements of written and electronic communication such as accurate spelling, grammar, and format.

2.5 Communicate information and ideas effectively to multiple audiences using a variety of media and formats.

2.6 Advocate and practice safe, legal, and responsible use of digital media information and communications technologies.

2.7 Use technical writing and communication skills to work effectively with diverse groups of people.

2.8 Understand the principles of a customer-oriented service approach to users.

3.0 Career Planning and Management

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)

3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.

3.2 Evaluate personal character traits such as trust, respect, and responsibility and understand the impact they can have on career success.

3.3 Explore how information and communication technologies are used in career planning and decision making.

3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.

3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.

3.6 Recognize the role and function of professional organizations, industry associations, and organized labor in a productive society.

3.7 Recognize the importance of small business in the California and global economies.

3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.

3.9 Develop a career plan that reflects career interests, pathways, and postsecondary options.

4.0 Technology

Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Information and Communication Technologies sector workplace environment. (Direct alignment with WS 11-12.6)

4.1 Use electronic reference materials to gather information and produce products and services.

4.2 Employ technology based communications responsibly and effectively to explore complex systems and issues.

4.3 Use information and communication technologies to synthesize, summarize, compare, and contrast information from multiple sources.

4.4 Discern the quality and value of information collected using digital technologies, and recognize bias and intent of the associated sources.

4.5 Research past, present, and projected technological advances as they impact a particular pathway.

4.6 Assess the value of various information and communication technologies to interact with constituent populations as part of a search of the current literature or in relation to the information task.

5.0 Problem Solving and Critical Thinking

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Information and Communication Technologies sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-12.7)

5.1 Identify and ask significant questions that clarify various points of view to solve problems.

5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

5.5 Use a logical and structured approach to isolate and identify the source of problems and to resolve problems.

5.6 Know the available resources for identifying and resolving problems.

5.7 Work out problems iteratively and recursively.

5.8 Create and use algorithms and solve problems.

5.9 Deconstruct large problems into components to solve.

5.10 Use multiple layers of abstraction.

5.11 Understand the concept of base systems, including binary and hexadecimal.

5.12 Apply the concepts of Boolean logic to decision making and searching.

6.0 Health and Safety

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Information and Communication Technologies sector workplace environment. (Direct alignment with RSTS 9-10, 11-12.4)

6.1 Locate, and adhere to, Material Safety Data Sheet (MSDS) instructions.

6.2 Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities.

6.3 Use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.

6.4 Practice personal safety when lifting, bending, or moving equipment and supplies.

6.5 Demonstrate how to prevent and respond to work-related accidents or injuries; this includes demonstrating an understanding of ergonomics.

6.6 Maintain a safe and healthful working environment.

6.7 Be informed of laws/acts pertaining to the Occupational Safety and Health Administration (OSHA).

6.8 Maintain a safe and healthful working environment.

6.9 Dispose of e-waste properly, understanding the health, environmental, and legal risks of improper disposal.

6.10 Act conscientiously regarding the use of natural resources (e.g., paper, ink, etc.)

6.11 Conserve energy while computing (e.g., turn off equipment at night, power-saving settings, etc.)

7.0 Responsibility and Flexibility

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Information and Communication Technologies sector workplace environment and community settings. (Direct alignment with SLS 9-10, 11-12.1)

7.1 Recognize how financial management impacts the economy, workforce, and community.

7.2 Explain the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.

7.3 Understand the need to adapt to changing and varied roles and responsibilities.

7.4 Practice time management and efficiency to fulfill responsibilities.

7.5 Apply high-quality techniques to product or presentation design and development.

7.6 Demonstrate knowledge and practice of responsible financial management.

7.7 Demonstrate the qualities and behaviors that constitute a positive and professional work demeanor, including appropriate attire for the profession.

7.8 Explore issues of global significance and document the impact on the Information and Communication Technologies sector.

8.0 Ethics and Legal Responsibilities

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms. (Direct alignment with SLS 11-12.1d)

8.1 Access, analyze, and implement quality assurance standards of practice.

8.2 Identify local, district, state, and federal regulatory agencies, entities, laws, and regulations related to the Information and Communication Technologies industry sector.

8.3 Demonstrate ethical and legal practices consistent with Information and Communication Technologies sector workplace standards.

8.4 Explain the importance of personal integrity, confidentiality, and ethical behavior in the workplace.

8.5 Analyze organizational culture and practices within the workplace environment.

8.6 Adhere to copyright and intellectual property laws and regulations, and use and appropriately cite proprietary information.

8.7 Conform to rules and regulations regarding sharing of confidential information, as determined by Information and Communication Technologies sector laws and practices.

8.8 Identify legal and ethical issues that have proliferated with increased technology adoption, including hacking, scamming, and breach of privacy.

9.0 Leadership and Teamwork

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution such as those practiced in the Future Business Leaders of America and SkillsUSA career technical student organization. (Direct alignment with SLS 11-12.1b)

9.1 Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.

9.2 Identify the characteristics of successful teams, including leadership, cooperation, collaboration, and effective decision-making skills as applied in groups, teams, and career technical student organization activities.

9.3 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.4 Explain how professional associations and organizations and associated leadership development and competitive career development activities enhance academic preparation, promote career choices, and contribute to employment opportunities.

9.5 Understand that the modern world is an international community and requires an expanded global view.

9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.

9.7 Participate in interactive teamwork to solve real Information and Communication Technologies sector issues and problems.

10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the Information and Communication Technologies sector, following procedures when carrying out experiments or performing technical tasks. (Direct alignment with WS 11-12.6)

10.1 Interpret and explain terminology and practices specific to the Information and Communication Technologies sector.

10.2 Comply with the rules, regulations, and expectations of all aspects of the Information and Communication Technologies sector.

10.3 Construct projects and products specific to the Information and Communication Technologies sector requirements and expectations.

10.4 Collaborate with industry experts for specific technical knowledge and skills.

10.5 Understand the major software and hardware components of a computer and a network and how they relate to each other.

10.6 Understand data sizes of various types of information (text, pictures, sound, video, etc.) and data capacity of various forms of media.

10.7 Understand the SI (metric) prefixes commonly used in computing including, at least, kilo, mega, giga, and tera.

10.8 Understand security concepts including authorization, rights, and encryption.

10.9 Use common industry-standard software and their applications including word processing, spreadsheets, databases, and multimedia software.

10.10 Manage files in a hierarchical system.

10.11 Know multiple ways in which to transfer information and resources (e.g., text, data, sound, video, still images) between software programs and systems.

10.12 Know appropriate search procedures for different types of information, sources, and queries.

10.13 Evaluate the accuracy, relevance, and comprehensiveness of retrieved information.

10.14 Analyze the effectiveness of online information resources to support collaborative tasks, research, publications, communications, and increased productivity.

11.0 Demonstration and Application

Demonstrate and apply the knowledge and skills contained in the Information and Communication Technologies anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through career technical student organizations such as Future Business Leaders of America and SkillsUSA.

11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Information and Communication Technologies sector program of study.

11.2 Demonstrate proficiency in a career technical pathway that leads to certification, licensure, and/or continued learning at the postsecondary level.

11.3 Demonstrate entrepreneurship skills and knowledge of self-employment options and innovative ventures.

11.4 Employ entrepreneurial practices and behaviors appropriate to Information and Communication Technologies sector opportunities.

11.5 Create a portfolio, or similar collection of work, that offers evidence through assessment and evaluation of skills and knowledge competency as contained in the anchor standards, pathway standards, and performance indicators.

C. Software and Systems Development Pathway

Students in the Software and Systems Development pathway prepare for careers related to computer science that involve the design, development, implementation, maintenance, and management of systems that rely on software programs to satisfy the operational needs of modern business organizations. Persons with expertise in systems development and programming are critical to support operations like electronic commerce, medical records management, retail sales and inventory management, digital entertainment, and use of energy.

Sample occupations associated with this pathway:

- Computer Programmer
- Software Developer/Applications
- Information Security Analyst
- Web Developer
- E-Business/E-Commerce Specialist

C1.0 Identify and apply the systems development process.

- C1.1 Identify the phases of the systems development life cycle, including analysis, design, programming, testing, implementation, maintenance, and improvement.
- C1.2 Identify and describe models of systems development, systems development life cycle (SDLC), and agile computing.
- C1.3 Identify and describe how specifications and requirements are developed for new and existing software applications.
- C1.4 Work as a member of, and within the scope and boundaries of, a development project team.
- C1.5 Track development project milestones using the concept of versions.
- C1.6 Diagram processes using flowcharts and the Unified Modeling Language.

C2.0 Define and analyze systems and software requirements.

- C2.1 Describe the major purposes and benefits of development, including automation, improving productivity, modeling and analysis, and entertainment.
- C2.2 Recognize and prevent unintended consequences of development work: programming errors, security issues, health and environmental risks, and privacy concerns.
- C2.3 Develop strategies that target the specific needs and desires of the customer.
- C2.4 Analyze customers' needs for development.
- C2.5 Determine and document the requirements and alternative solutions to fulfill the customers' needs.

C3.0 Create effective interfaces between humans and technology.

- C3.1 Describe and apply the basic process of input, processing, and output.

C3.2 Design effective and intuitive interfaces using knowledge of cognitive, physical, and social interactions.

C3.3 Support methods of accessibility for all potential users, including users with disabilities and non-English-speaking users.

C4.0 Develop software using programming languages.

C4.1 Identify and describe the abstraction level of programming languages from low-level, hardware-based languages to high-level, interpreted, Web-based languages.

C4.2 Describe the interaction and integration of programming languages and protocols such as how client-side programming can work with server-side programming to use a query language to access a database.

C4.3 Identify and use different authoring tools and integrated development environments (IDEs).

C4.4 Identify and apply data types and encoding.

C4.5 Demonstrate awareness of various programming paradigms, including procedural, object oriented, event-driven, and multithreaded programing.

C4.6 Use proper programming language syntax.

C4.7 Use various data structures, arrays, objects, files, and databases.

C4.8 Use object oriented programming concepts, properties, methods, and inheritance.

C4.9 Create programs using control structures, procedures, functions, parameters, variables, error recovery, and recursion.

C4.10 Create and know the comparative advantages of various queue, sorting, and searching algorithms.

C4.11 Document development work for various audiences, such as comments for other programmers, and manuals for users.

C5.0 Test, debug, and improve software development work.

C5.1 Identify the characteristics of reliable, effective, and efficient products.

C5.2 Describe the ways in which specification changes and technological advances can require the modification of programs.

C5.3 Use strategies to optimize code for improved performance.

C5.4 Test software and projects.

C5.5 Evaluate results against initial requirements.

C5.6 Debug software as part of the quality assurance process.

C6.0 Integrate a variety of media into development projects.

C6.1 Identify the basic design elements necessary to produce effective print, video, audio, and interactive media.

C6.2 Describe the various encoding methods of media and trade-offs: vector graphics vs. bitmaps, and bit depth.

C6.3 Use media design and editing software: keyframe animation, drawing software, image editors, and three-dimensional design.

C6.4 Develop a presentation or other multimedia project: video, game, or interactive Web sites, from storyboard to production.

C6.5 Analyze the use of media to determine the appropriate file format and level of compression.

C6.6 Integrate media into a full project using appropriate tools.

C6.7 Create and/or capture professional-quality media, images, documents, audio, and video clips.

C7.0 Develop Web and online projects.

C7.1 Identify the hardware (server) and software required for Web hosting and other services.

C7.2 Describe the full process of online content delivery, registering domain names, setting up hosting, and setting up e-mail addresses.

C7.3 Attract Web-site visitors through search engine optimization using various strategies like keywords and meta-tags.

C7.4 Enable e-commerce capabilities to sell products, create a shopping cart, and handle credit card transactions.

C7.5 Create an online project, Web-based business, and e-portfolio.

C7.6 Optimize fast delivery and retrieval of online content such as Web pages.

C8.0 Develop databases.

C8.1 Describe the critical function of databases in modern organizations.

C8.2 Identify and use the basic structures of databases, fields, records, tables, and views.

C8.3 Identify and explain the types of relationships between tables (one-to-one, one-to-many, many-to-many) and use methods to establish these relationships, including primary keys, foreign keys, and indexes.

C8.4 Use data modeling techniques to create databases based upon business needs.

C8.5 Use queries to extract and manipulate data (select queries, action queries).

C8.6 Develop databases that are properly normalized using appropriate schemas.

C8.7 Export and import data to and from other applications and a database recognizing the limitations and challenges inherent in the process.

C8.8 Analyze and display data to assist with decision making using methods like cross tabulations, graphs, and charts.

C9.0 Develop software for a variety of devices, including robotics.

C9.1 Demonstrate awareness of the applications of device development work, including personalized computing, robotics, and smart appliances.

C9.2 Install equipment, assemble hardware, and perform tests using appropriate tools and technology.

C9.3 Use hardware to gain input, process information, and take action.

C9.4 Apply the concepts of embedded programming, including digital logic, machine-level representation of data, and memory-system organization.

C9.5 Program a micro-controller for a device or robot.

C10.0 Develop intelligent computing.

C10.1 Describe models of intelligent behavior and what distinguishes humans from machines.

C10.2 Describe the major areas of intelligent computing, including perception, proximity, processing, and control.

C10.3 Know artificial intelligence methods such as neural networks, Bayesian inferences, fuzzy logic, and finite state machines.

C10.4 Implement artificial intelligent behavior through various methods: mathematical modeling, reinforcement learning, and probabilistic analysis.