Cybersecurity Operations

6304/36 weeks

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Acknowledgments

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Correlations to the Virginia Standards of Learning were reviewed and updated by the following:

- Leslie R. Bowers, English Teacher (ret.), Newport News Public Schools
Course Description

Suggested Grade Level: 10 or 11 or 12

Cybersecurity Operations is designed to teach computer and network administration and security. Students learn cybersecurity concepts, including the practice of protecting systems, networks, and programs from digital attacks. Cybersecurity is defined as the steps and processes taken to protect networks, devices, programs, and data from unauthorized access that can result in theft or damage. Students learn to establish, implement, and maintain security networks.

Recommended prerequisite(s): Keyboarding course(s) or teacher-approved demonstration and documentation of touch keyboarding skills and Cybersecurity Fundamentals 6302.

Task Essentials Table

- Tasks/competencies designated by plus icons (怙) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (〇) are optional
- Tasks/competencies designated by minus icons (●) are omitted
- Tasks marked with an asterisk (*) are sensitive.

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<td>Identify copyright and licensing laws that apply to computer use and network administration.</td>
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<td>Describe procedures to ensure the proper licensing of a client-server operating system (OS) and applications.</td>
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<td>Define aspects of networks.</td>
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<td>Describe the functions of networking infrastructure (e.g., adapter, router, switch, bridge, wireless access point).</td>
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**Developing Employability Skills**

| 96 | ☑ | Research careers in networking and systems security. |
| 97 | ☑ | Compose a résumé for electronic processing. |
| 98 | ☑ | Assemble a professional portfolio that contains representative samples of student work. |
| 99 | ☑ | Create a cover letter to accompany a résumé. |
| 100 | ☑ | Complete manual and electronic application forms. |
| 101 | ☑ | Participate in an internship program. |
| 102 | ☑ | Research a company in preparation for a job interview. |
| 103 | ☑ | Participate in a mock interview. |
| 104 | ☑ | Compose an interview follow-up letter. |
| 105 | ☑ | Identify the steps to follow when resigning from a position. |
| 106 | ☑ | Identify potential employment barriers for nontraditional groups and ways to overcome these barriers. |

Legend: ☑Essential ☐Non-essential ☐Omitted

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**Curriculum Framework**

**Performing Legal and Ethical Functions**

**Task Number 39**

**Identify copyright and licensing laws that apply to computer use and network administration.**

**Definition**

Identification should include laws and regulations that govern the use of software, information (i.e., text), and graphics.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills

3D Animation
Task Number 40

Describe procedures to ensure the proper licensing of a client-server operating system (OS) and applications.

Definition
Description should include steps for developing a method for tracking server connection and software licenses and identifying unlicensed versions of software.
Task Number 41

Identify ethical behavior that is expected of users and administrators.

Definition
Identification should include listing ethical concerns that an administrator may encounter and be expected to handle responsibly, such as

- privacy issues
- nondisclosure of confidential information
- legal use of copyrighted material
- personally identifiable information (PII) (e.g., phone numbers, social security numbers, birth dates).

Task Number 42 (O)

Describe for documentation found in network policies.

Definition
Description should include

- documentation of the network
• policies and procedures to maintain and update the network
  o change of personnel in the event of disaster
  o avoidance of network penetration
• safety assurance
• risk management
• security policies.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills

Business Ethics

Business Law

Coding and Programming

Computer Game and Simulation Programming

Cyber Security

Healthcare Administration

Management Information Systems

Network Design

Networking Infrastructures

**Introducing Network Design Essentials**

**Task Number 43**

**Define aspects of networks.**

**Definition**

Definition should include

• terms
  o **local area network (LAN)**
  o **virtual local area network (VLAN)**
  o **wide area network (WAN)**
  o **wireless local area network (WLAN)**
  o **personal area network (PAN)**
• benefits and limitations of each type
• components required to make a network operational
• typical hardware components
• sample business configurations
• communication medium (e.g., wired, wireless).

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills

Coding and Programming

Computer Game and Simulation Programming

Cyber Security

Management Information Systems

Network Design
Networking Infrastructures

Task Number 44 (O)

Define types of network architecture.

Definition
Definition should include

- architecture (e.g., peer-to-peer, server-based [domain controlled])
- sample business configurations
- benefits and limitations of each.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Management Information Systems
Network Design
Networking Infrastructures

Task Number 45 (O)

Differentiate between distributed and centralized computing.

Definition
Differentiation should include characteristics and advantages of

- distributed computing
- centralized computing
- cloud computing.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 46

Identify services delivered by a server.
Definition
Identification should include

• application
• communication
• domain and/or directory
• fax
• file
• print
• mail transfer agent (MTA)
• web
• database

and should also include ways to access various servers.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 47
Analyze specialized server hardware.

Definition
Analysis should include

• uses
• characteristics
• role in the network environment
• cost and benefit analysis
• hardware specifications (e.g., redundant array of independent disks [RAID], hot-swappable devices)
• importance of higher system requirements (e.g., symmetric multiprocessing [SMP], Small Computer System Interface [SCSI] storage, additional random access memory [RAM], or central processing unit [CPU]).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Task Number 48 (O)

Describe standard network LAN topologies.

Definition
Description should include a comparison of the features, functions, characteristics, and financial considerations of network LAN topologies.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 49

Describe variations of standard topologies.

Definition
Description should include a comparison of the features, functions, characteristics, and financial considerations of the variations of standard topologies (e.g., mesh, star, bus, ring).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 50

Describe the role of the network adapter.

Definition
Description should include
• tasks performed
• characteristics that may vary among manufacturers’ cards
• explanations of the media access card (MAC) address and its uses
• media type (e.g., wired [fiber or copper attached], wireless, Bluetooth)
• speed and bandwidth.

**FBLA Competitive Events and Activities Areas**

**Business Knowledge and Skills**

**Coding and Programming**

**Computer Game and Simulation Programming**

**Cyber Security**

**Database Design and Application**

**Management Information Systems**

**Network Design**

**Networking Infrastructures**

**Task Number 51**

**Describe the functions of networking infrastructure (e.g., adapter, router, switch, bridge, wireless access point).**

**Definition**

Description should include

• network addressing
• media conversion
• address translation
• security
• protocol conversion and virtual private network (VPN)
• packet routing.

**FBLA Competitive Events and Activities Areas**

**Business Knowledge and Skills**

**Coding and Programming**

**Computer Game and Simulation Programming**

**Cyber Security**

**Database Design and Application**

**Management Information Systems**

**Network Design**

**Networking Infrastructures**

**Exploring Networking Media**

**Task Number 52**

**Identify the types and uses of wired network media.**
Definition
Identification should include

- discussion of and comparison among features, functions, and characteristics
- financial considerations of cable types
  - copper
  - coaxial
  - twisted pair cabling
  - fiber optic (e.g., single mode, multimode).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 53
Identify the types and uses of wireless network media.

Definition
Identification should include

- wireless local area network (e.g., WiFi)
- Bluetooth
- cellular.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 54
Define terms related to wired and wireless network media.

Definition
Definition of terms should include
functions and characteristics
Wi-Fi (IEEE 802.11) wireless protocol and associated channels
ethernet (IEEE 802.3) wired protocol
wired network issues
  o cable length
  o connection type (e.g., fiber optic, category [CAT]5/6, coaxial)
wireless issues
  o channels
  o frequencies
  o interference
  o distance and attenuation.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 55 (O)

Describe the concept of broadband.

Definition
Description should include

  • digital subscriber line (DSL), cable, fiber optics, high-speed wireless, transmission system lines 1 and 3 (T1 and T3)
  • characteristics and functions of broadband transmissions
  • different situations in which various incarnations of broadband might be used.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 56 (O)

Describe a modem.
**Definition**

Description should include

- characteristics and functions of modem communications
- examples
  - analog
  - coaxial cable
  - asymmetric digital subscriber line (DSL)
  - Integrated Services Digital Network (ISDN), T1, T3 lines.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Understanding Networking Standards and Models**

**Task Number 57**

**Describe each layer of the Open Systems Interconnection (OSI) model.**

**Definition**

Description should include the

- identification of each layer
- primary function of each layer
- method of interaction between layers of computing and networking activities.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 58**
Describe devices in a network environment and their place in the OSI model.

**Definition**

Description should include

- elements of a network environment
- explanation of each device’s role
- each device's place in the OSI model
- switches
  - switch access
  - switch management
  - virtual LAN
  - trunking
  - Spanning Tree Protocol (STP)
- routers
  - routing basics
  - routing protocols
  - network address translation
  - routing optimization
- firewalls
  - security appliances
  - firewall design and implementation.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills

Coding and Programming

Computer Game and Simulation Programming

Cyber Security

Database Design and Application

Management Information Systems

Network Design

Networking Infrastructures

**Task Number 59**

Define the basic components of a network packet.

**Definition**

Definition should include the components of a network packet including but not limited to

- headers
- body
- footers
- network addressing
- check sums.

**FBLA Competitive Events and Activities Areas**

Business Knowledge and Skills

Coding and Programming

Computer Game and Simulation Programming
Task Number 60

Describe networking protocols.

Definition

Description should include the

- ethernet and/or Wi-Fi
- Transmission Control Protocol (TCP)
- Internet Protocol (IP) versions 4 and 6
- User Datagram Protocol (UDP)
- application layer protocols (Hypertext Transfer Protocol [HTTP], File Transfer Protocol [FTP])
- roles in data transmission across networks.

Task Number 61

Describe address resolution and/or assignment and wireless authentication.

Definition

Description should address

- Dynamic Host Control Protocol (DHCP)
  - discover, offer, requests, acknowledge
- Domain Name Server (DNS)
- Address Resolution Protocol (ARP).

Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Task Number 62 (O)


**Definition**
Configuration should include a static address including an IP address, subnet mask, and gateway.

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 63

Test a TCP/IP configuration, using OS-specific commands.

**Definition**
Testing could include using OS-specific commands (e.g., ping, network statistics, ipconfig/ifconfig, trace route [TRACERT], nslookup).

Note: Systems being modified require a virtual machine found in the [Virginia Cyber Range](https://www.virginiacyberrange.org/).

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures
Task Number 64

Identify the network and host identifications’ TCP/IP addresses.

Definition
Identification should include the requirements for addresses, based on class addresses.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 65

Compare IPv4 and IPv6.

Definition
Comparison should include identification of features and anticipated developments in IPv4 and IPv6.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 66

Describe a loopback address.

Definition
Description should include how the loopback range tests a TCP/IP protocol implementation on a host.
Task Number 67

Explain the purpose of the Simple Network Management Protocol (SNMP).

Definition

Explanation should include

- managing requests for status information from multiple hosts
- reporting significant events (traps) to multiple hosts
- using hosts' names and IP addresses to identify the hosts from which SNMP receives requests and to which SNMP reports information

Using Desktop and Mobile Systems Concepts

Task Number 68

Navigate an end user’s digital OS network and/or environment.

Definition

Navigation should include using digital OS tools, such as system utilities (e.g., disk cleanup, disk defragmenter, system restore).
Task Number 69

Compare digital operating systems.

Definition
Comparison should include:

- defining the term *operating system* (OS)
- describing the functions and characteristics unique to specific digital OS (e.g., Microsoft Windows, Mac OS, Linux)
- describe the differences between command line interface (CLI) and graphical line interface (GUI)
- differentiating between traditional computer OS and mobile OS, such as Android and IOS.

Task Number 70

Navigate the digital OS environment.

Definition
Navigation should include using system utilities, system administrative tools, file structure tools, and hardware management tools and

- registry management (e.g., Windows)
- command-line management skills
- task and process management
- demonstrating the use of GUI and CLI to perform file and administrative tasks.
FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 71 (O)**

**Demonstrate the procedures followed when installing digital OS.**

**Definition**

Demonstration should include

- stopping unnecessary services
- removing unnecessary administrative rights from users
- removing unnecessary software
- locking down or hardening a desktop OS.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 72**

**Manage a file system structure.**

**Definition**

Management should include

- organizing files by various methods (e.g., create, modify, and delete)
- identifying appropriate location of files based on function and use
- differentiating between a file system structure and an end-user file system structure
  - multiple drives (i.e., local, cloud)
  - hidden and protected files
  - directory permissions
  - Universal Naming Convention (UNC).
Task Number 73

Compare server OS.

Definition
Comparison should include evaluating the benefits and limitations of current server operating systems, including

- Microsoft server operating systems
- Linux/UNIX distributions
- general discussion of the general varieties of Linux distributions (i.e., Ubuntu, Debian, CentOS, Kali).

Task Number 74

Explain file system formats.

Definition
Explanation should include characteristics, associated OS, and benefits and limitations of different file system formats. Explanation should also include

- file allocation table (FAT and FAT32)
- Microsoft New Technology File System (NTFS)
- compact disc file system (CDFS)
- universal disk format (UDF)
• Linux extended variants (Ext2, Ext3, Ext4)
• high-performance file system (HPFS)
• media access control (MAC).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 75

Explain the authentication of users in a network environment.

Definition
Explanation should include the relationship among

• authentication vs. authorization
• single or multi-factor authentication options
• the process for logging a user onto a server and network, based on the client service's software
• the server’s security features
• common security issues with network authentication.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 76 (O)

Install applications.

Definition
Installation should include performing the steps required to install additional client-services software in a heterogeneous environment, (e.g., email, office productivity apps) and services
(e.g., file sharing, printing) commonly found in a client-server environment, following the manufacturer installation instructions.

Note: Systems being modified require a virtual machine similar to the one found in the Virginia Cyber Range (https://www.virginiacyberrange.org/).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Ensuring Network Security

Task Number 77
Monitor network traffic.

Definition
Monitoring should include interpreting network traffic using a protocol analyzer (e.g., network monitor [Windows], open source [Wireshark], or tcpdump).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 78
Analyze network systems for cybersecurity vulnerabilities.

Definition
Analysis should include detection of vulnerabilities-when using

- port scanning (i.e., Network Mapper [Nmap])
- software update services
- baseline creation
- industry standard vulnerability scanning assessments, such as Nessus
• other tools, such as Microsoft Baseline Security Analyzer (MBSA)
• normal network traffic
• malicious network traffic (i.e., ARP poisoning, teardrop attack, SMURF attack).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 79

Explain the core cybersecurity principles used in network management.

Definition
Explanation should include

• authentication, authorization, and accounting (AAA)
• confidentiality, integrity, and availability (CIA Triad)
• secure password storage (password hashing)
• file integrity (checksum).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 80

Analyze cybersecurity threats and risks to networks and local policies.

Definition
Analysis of threats and risks should include

• differentiating between a threat and a risk
• identifying internal and external threats and risks
- prioritizing various threats and risks
- reporting threats and risks.

**FBLA Competitive Events and Activities Areas**
- Business Knowledge and Skills
- Coding and Programming
- Computer Game and Simulation Programming
- Cyber Security
- Database Design and Application
- Management Information Systems
- Network Design
- Networking Infrastructures

**Task Number 81**

**Analyze cybersecurity internal and external threats to computer networks.**

**Definition**
Analysis should include threats from
- employees
- natural disasters
- malware
- common vulnerability and exposures (CVE)
- common vulnerability scoring system (CVSS)
- unknown hackers.

Teacher resource:
[Common Vulnerability Scoring System](https://www.first.org/cvss/)

**FBLA Competitive Events and Activities Areas**
- Business Knowledge and Skills
- Coding and Programming
- Computer Game and Simulation Programming
- Cyber Security
- Database Design and Application
- Management Information Systems
- Network Design
- Networking Infrastructures

**Task Number 82**

**Review strategies to mitigate risk.**

**Definition**
Review of risks should include
avoidance
transfer
mitigation
acceptance.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 83 (O)
Install a virtualized OS.

Definition
Installation should include using one of the following:

- Hyper-V (Microsoft)
- VMware
- Virtual PC
- VirtualBox (open source)
- Other tools.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 84 (O)
Describe the different types of network adapter modes for virtual OS.

Definition
Description should include

- bridged mode
- network address translation (NAT) mode
- host-only mode.

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 85**

Compare security scanning tools such as intrusion detection system (IDS) and intrusion prevention system (IPS) and security appliances.

**Definition**
Comparison should include

- differentiation between an IDS and IPS
- benefits and drawbacks of all-in-one security appliances.

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 86**

Identify threats and vulnerabilities from users.

**Definition**
Identification should include differentiating between a threat and a vulnerability, as well as

- email use
- insider threats
- employee errors
- weak management
  - weak policy creation
o unused accounts
o weak password selection.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 87
Identify security measures taken against physical threats to network systems.

Definition
Identification should include

- locks
- mantraps
- security cameras
- policies
- badging.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 88
Identifying other risks and threats to systems.

Definition
Identification should include

- wireless rogue networks
- bring-your-own device (BYOD)
- Internet of things (IoT) devices.
Task Number 89

Explore digital forensics.

Definition

Exploration could include

- digital forensics in the context of a network attack
  - defining the anatomy of the attack
- digital forensics in the context of a law enforcement investigation
  - defining search and seizure of evidence (i.e., digital, physical)
  - package and transport evidence
  - chain of custody
- digital forensics toolkit

Teacher resources:

- CYBER.ORG (https://cyber.org/)
- Virginia Cyber Range (https://www.virginiacyberrange.org/)
- Laws for data compromised crimes
- The Definitive Guide to US State Data Breach Law
Identify training needs.

Definition
Identification should include

- login steps
- FTP
- print operations
- systems and information use
- steps to secure data and access data backups
- security awareness.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures

Task Number 91

Provide an orientation to a network system (system onboarding).

Definition
Provision should include an orientation involving the use of a well-organized network system guide that articulates

- procedures to log in to the network
- methods used to access resources on the network
- processes used to resolve common problems
- security considerations.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Computer Game and Simulation Programming
Cyber Security
Database Design and Application
Management Information Systems
Network Design
Networking Infrastructures
Preparing for Industry Certification

Task Number 92

Describe the process and requirements for obtaining industry certifications.

Definition
Description should include

- list of industry certifications
- process and/or requirements for obtaining the certifications
- official websites of the testing organization and/or vendor
- materials from publishers that have developed practice materials and tests based on information from the testing organization and/or vendor
- information from certified instructors or industry-certified professionals.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

Task Number 93

Identify testing skills and strategies for a certification examination.

Definition
Identification should be undertaken by

- conducting an Internet research project
- reviewing materials from exam and practice-exam publishers
- interviewing certified instructors and/or industry-certified professionals.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

Task Number 94

Demonstrate the ability to complete selected practice examinations (e.g., practice questions similar to those on certification exams).

Definition
Demonstration should include successfully completing practice examinations for selected certifications related to the course obtained from vendor sites and/or materials from publishers. The level of performance on a practice examination serves as a gauge of the applicant's readiness for formal industry testing.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

Task Number 95

Complete an industry certification examination representative of skills learned in this course.

Definition
Completion of an industry certification examination is achieved when the student applicant earns an examination score deemed "passing" by the testing organization.

Qualifying examinations are those currently approved at the state level as representative of Cybersecurity Software Operations skills.

Students should be encouraged to attain industry certification as evidence of their computer network software operations skill level and general employability.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Developing Employability Skills

Task Number 96

Research careers in networking and systems security.

Definition
Researching should include

- exploring advancement opportunities
- analyzing employment trends
- utilizing job database to match personal abilities, aptitudes, and job expectations with industry standards.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

Task Number 97

Compose a résumé for electronic processing.

Definition
Composition should include

- educational background
- work history
- honors and awards
- extracurricular activities (e.g., membership in clubs, leadership positions held, community service).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Business Communications
Task Number 98 (O)

Assemble a professional portfolio that contains representative samples of student work.

Definition

Assembly should include a

- résumé in a format suitable for online posting
- combination of electronic and non-electronic documents that reflect the student’s knowledge, skills, and abilities
- representation of the student’s work (e.g., program design, source code, technical documentation, output).

Task Number 99 (O)

Create a cover letter to accompany a résumé.

Definition

Creation of a cover letter should include

- following the business letter format
- writing three or four short paragraphs emphasizing salient résumé points
- indicating familiarity with the company
- indicating whether applying for the position is confidential
- explaining why the position is desired
- addressing the letter to the appropriate individual.
FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Business Communications
Computer Applications
Electronic Career Portfolio
Future Business Leader
Introduction to Business Communications
Job Interview
Scholarships
Word Processing

Task Number 100 (O)
Complete manual and electronic application forms.

Definition
Completion of manual applications should include

- finishing all sections of employment applications (e.g., name, address, education, work experiences, job title, references, other qualifications)
- utilizing good penmanship
- being prepared (e.g., having copies of résumé and all other relevant information)
- securing references (e.g., obtaining permission before providing them).

Completion of electronic applications should

- include providing complete, accurate, and effectively organized information
- consideration of criteria specifically related to the electronic transmittal of application information (e.g., attention to security concerns, inclusion of keywords to enhance interest in the application, use of scanner-friendly format).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Business Communications
Computer Applications
Electronic Career Portfolio
Future Business Leader
Introduction to Business Communications
Job Interview
Scholarships
Word Processing

Task Number 101 (O)
Participate in an internship program.
**Definition**
Participation should include

- finding an internship program within the field
- following an instructor’s or counselor’s guidance
- obtaining consent from parent(s) or legal guardian(s)
- committing to the internship contract.

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 102**

**Research a company in preparation for a job interview.**

**Definition**
Research should include using resources and

- gathering background information through website, annual reports, human resources department
- focusing on the company's mission, history, vision, and additional information.

**FBLA Competitive Events and Activities Areas**
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

**Task Number 103 (O)**

**Participate in a mock interview.**
Definition
Participation should include

• playing a variety of roles in the interview to identify behaviors that are both desirable (e.g., maintaining eye contact, asking informed questions) and undesirable (e.g., speaking too softly, failing to answer questions completely) as displayed by the participant
• utilizing technical terms and knowledge when answering questions
• displaying knowledge of company.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures

Task Number 104 (O)

Compose an interview follow-up letter.

Definition
Composition should include

• following the business letter format
• expressing appreciation for the opportunity to interview
• reminding the interviewer of the qualifications that were discussed
• confirming interest in the job
• address next steps if not provided during interview.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Business Communications
Computer Applications
Electronic Career Portfolio
Future Business Leader
Introduction to Business Communications
Job Interview
Scholarships
Word Processing

Task Number 105 (O)

Identify the steps to follow when resigning from a position.
Definition
Identification should include

- preparing a formal resignation notification
- providing ample time to find a replacement (usually two weeks).

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Business Communications
Computer Applications
Electronic Career Portfolio
Future Business Leader
Introduction to Business Communications
Job Interview
Scholarships
Word Processing

Task Number 106
Identify potential employment barriers for nontraditional groups and ways to overcome these barriers.

Definition
Identification of potential employment barriers should include

- gender
- ethnicity
- age
- discrimination in hiring or promoting practices.

Identification of ways to overcome the barriers should include

- scholarships
- job training programs
- mentorships
- minority assistance programs.

FBLA Competitive Events and Activities Areas
Business Knowledge and Skills
Coding and Programming
Cyber Security
Database Design and Application
Electronic Career Portfolio
Job Interview
Management Information Systems
Network Design
Networking Infrastructures
<table>
<thead>
<tr>
<th>Task</th>
<th>English:</th>
<th>Social Studies:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify copyright and licensing laws that apply to computer use and network administration.</td>
<td>10.5, 11.5, 12.5</td>
<td>VUS 14; Govt 9, 14, 15</td>
</tr>
<tr>
<td>Describe procedures to ensure the proper licensing of a client-server operating system (OS) and applications.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Identify ethical behavior that is expected of users and administrators.</td>
<td>10.5, 10.6, 11.5, 11.6, 12.5, 12.6</td>
<td>VUS 14; Govt 9, 14, 15</td>
</tr>
<tr>
<td>Describe for documentation found in network policies.</td>
<td>10.5, 10.6, 10.7, 11.5, 11.6, 11.7, 12.5, 12.6, 12.7</td>
<td></td>
</tr>
<tr>
<td>Define aspects of networks.</td>
<td>10.3, 10.5, 11.3, 11.5, 12.3, 12.5</td>
<td></td>
</tr>
<tr>
<td>Define types of network architecture.</td>
<td>10.3, 10.5, 11.3, 11.5, 12.3, 12.5</td>
<td></td>
</tr>
<tr>
<td>Differentiate between distributed and centralized computing.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Identify services delivered by a server.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Analyze specialized server hardware.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe standard network LAN topologies.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe variations of standard topologies.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe the role of the network adapter.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe the functions of networking infrastructure (e.g., adapter, router, switch, bridge, wireless access point).</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Identify the types and uses of wired network media.</td>
<td>10.1, 10.5, 11.1, 11.5, 12.1, 12.5</td>
<td></td>
</tr>
<tr>
<td>Identify the types and uses of wireless network media.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Define terms related to wired and wireless network media.</td>
<td>10.3, 10.5, 11.3, 11.5, 12.3, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe the concept of broadband.</td>
<td>10.5, 11.5, 12.5</td>
<td>VUS 14; Govt 9, 14, 15</td>
</tr>
<tr>
<td>Describe a modem.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe each layer of the Open Systems Interconnection (OSI) model.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe devices in a network environment and their place in the OSI model.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Define the basic components of a network packet.</td>
<td>10.3, 10.5, 11.3, 11.5, 12.3, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe networking protocols.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe address resolution and/or assignment and wireless authentication.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Task Description</td>
<td>English:</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
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<td></td>
</tr>
<tr>
<td>Test a TCP/IP configuration, using OS-specific commands.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Identify the network and host identifications’ TCP/IP addresses.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Compare IPv4 and IPv6.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Describe a loopback address.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Explain the purpose of the Simple Network Management Protocol (SNMP).</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Navigate an end user’s digital OS network and/or environment.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Compare digital operating systems.</td>
<td>10.3, 10.5, 11.3, 11.5, 12.3, 12.5</td>
<td></td>
</tr>
<tr>
<td>Navigate the digital OS environment.</td>
<td>10.2, 10.5, 11.2, 11.5, 12.2, 12.5</td>
<td></td>
</tr>
<tr>
<td>Demonstrate the procedures followed when installing digital OS.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Manage a file system structure.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Compare server OS.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Explain file system formats.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Explain the authentication of users in a network environment.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Install applications.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Monitor network traffic.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Analyze network systems for cybersecurity vulnerabilities.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Explain the core cybersecurity principles used in network management.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
</tr>
<tr>
<td>Analyze cybersecurity threats and risks to networks and local policies.</td>
<td>10.5, 11.5, 12.5</td>
<td></td>
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</tr>
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<td></td>
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<tr>
<td>Identify security measures taken against physical threats to network systems.</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
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<td>10.5, 10.8, 11.5, 11.8, 12.5, 12.8</td>
<td></td>
</tr>
<tr>
<td>Identify training needs.</td>
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<td></td>
</tr>
<tr>
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<td></td>
</tr>
</tbody>
</table>
Describe the process and requirements for obtaining industry certifications. | English: 10.5, 10.6, 11.5, 11.6, 12.5, 12.6
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Demonstrate the ability to complete selected practice examinations (e.g., practice questions similar to those on certification exams). | English: 10.5, 11.5, 12.5
Complete an industry certification examination representative of skills learned in this course. | English: 10.5, 10.6, 10.7, 11.5, 11.6, 11.7, 12.5, 12.6, 12.7
Research careers in networking and systems security. | English: 10.5, 10.8, 11.5, 11.8, 12.5, 12.8
Compose a résumé for electronic processing. | English: 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
Assemble a professional portfolio that contains representative samples of student work. | English: 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
Create a cover letter to accompany a résumé. | English: 10.6, 10.7, 11.6, 11.7, 12.6, 12.7
Complete manual and electronic application forms. | English: 10.5, 10.6, 10.7, 11.5, 11.6, 11.7, 12.5, 12.6, 12.7
Participate in an internship program. | English: 10.5, 10.8, 11.5, 11.8, 12.5, 12.8
Research a company in preparation for a job interview. | English: 10.8, 11.8, 12.8
Participate in a mock interview. | English: 10.1, 10.5, 11.1, 11.5, 12.1, 12.5
Compose an interview follow-up letter. | English: 10.1, 11.1, 12.1
Identify the steps to follow when resigning from a position. | English: 10.5, 11.5, 12.5
Identify potential employment barriers for nontraditional groups and ways to overcome these barriers. | English: 10.5, 11.5, 12.5

### Teacher Resources

#### Instructional Scenarios

**Design Your Companies Authentication Backend**

**Duty/Concept Area(s):** Using Desktop and Mobile Systems Concepts

**Scenario:**
You are currently employed at WebWidgets Incorporated as a security consultant working on the redesign and development of their authentication systems. Your job is to design the backend authentication systems for a variety of outward-facing services. You need to provide compelling arguments as to what type of authentication and authorization solutions can satisfy the security and usability needs.

WebWidgets Incorporated has the following services that their employees need to access when outside the company network:
- Webmail service
- Gitlab repositories
- Team management system
The team has already had an initial briefing where they discussed the possibility of hosting all services on their internal network or using software-as-a-service (SaaS) solutions. The CEO has expressed concerns over security, but also knows they cannot sacrifice major accessibility.

You need to explore popular methods for managing multiple services through a single-sign on (SSO) either provided by a service or housed locally. You will also have to consider the possible vulnerabilities that an SSO introduces and how those can be mitigated.

After weighing the possibilities and choosing a design, you will need to prepare a presentation for the CEO consisting of two options for your team.

**Big Question:**
How do modern-day systems manage network accounts for authentication and authorization through a variety of services?

**Focused Questions:**
- What is SSO?
- What is SaaS?
- What are common industry solutions for SSO (internal or provided) and SaaS?
- What types of threats should be considered when implementing SSO or SaaS?
- How can these threats be mitigated?

**SOL Correlation:**
C/T 9-12.2, C/T 9-12.3, C/T 9-12.4, C/T 9-12.5

**Project-Based Assessment:**
Student(s) will work to create a presentation to compare to possible designs for the company’s new infrastructure.

Instructioanal scenario submitted by Karl Meister, Norview High School, Norfolk Public Schools, 2021.
Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Curriculum Resources

The Academic Initiative of the Cyber Innovation Center offers access to its curricula at no cost to K-12 teachers. These lessons could be used to supplement the following tasks:

- Task 40: Describe cybersecurity threats to an organization. (How Businesses Secure Information)
- Task 43: Describe the cyberattack surface of various organizations (How Businesses Secure Information)
- Task 64: Distinguish among types of ethical concerns. (Privacy vs. Security)
- Task 73: Explain the concept of "personally identifiable information." (You are the Data)
- Task 74: Explain how and why personal data is valuable to both an individual and to the organizations. (You are the Data)
- Task 75: Identify ways to control and protect personal data. (You are the Data)
- Task 77: Analyze the social and legal significance of the ongoing collection of personal digital information. (Your Permanent Electronic Record)

The National Institute of Standards and Technology has published the Glossary of Key Information Security Terms, which has been extracted from federal standards, publications, reports, and instructions.

The SANS Institute offers free professional development curricula focused on the fundamentals of cybersecurity. The course covers operating systems, networking, and systems administration.

The Virginia Cyber Range is a Commonwealth of Virginia initiative with a mission to enhance cybersecurity education for students in the Commonwealth’s public high schools, colleges, and universities. The Virginia Cyber Range seeks to increase the number of fully prepared students entering the cybersecurity workforce in operations, development, and research. The Virginia Cyber Range provides an extensive Courseware Repository for educators and a cloud-hosted Exercise Area environment for hands-on cybersecurity labs and exercises for students.

AFA CyberPatriot is the National Youth Cyber Education Program created by the Air Force Association to inspire K-12 students toward careers in cybersecurity or other science, technology, engineering, and mathematics (STEM) disciplines critical to our nation's future. At the core of the program is the National Youth Cyber Defense Competition, the nation's largest cyber defense competition that puts high school and middle school students in charge of securing virtual networks.
Net Etiquette

"What do I need to know about technology?" Northern Virginia Community College

"Netiquette." Justice Institute of British Columbia

Coding Standards

"SEI CERT Coding Standards," Software Engineering Institute, Carnegie-Mellon University

Open Web Application Security Project (OWASP), focused on improving the security of software.

Job-related Tools and Data

CyberSeek: Provides detailed data about supply and demand in cybersecurity fields, including an interactive state-by-state map which shows the field where demand is highest. For job seekers, educators, school counselors, and students.

“Breaking the Code on a Career in Cybersecurity”: Virginia Space Grant Consortium’s free video series, which features interviews with cyber professionals about their career pathways.
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- A+ Certification Examination
- Business Information Processing Assessment
- Certified Associate in Python Programming (PCAP) Examination
- Certified Entry-Level Python Programmer (PCEP) Examination
- Certified Internet Web (CIW) Advanced HTML 5 and CSS 3 Specialist Examination
- Certified Internet Web (CIW) Data Analyst Examination
- Certified Internet Web (CIW) Database Design Specialist Examination
- Certified Internet Web (CIW) E-Commerce Services Specialist Examination
- Certified Internet Web (CIW) Internet Business Associate Examination
- Certified Internet Web (CIW) JavaScript Specialist Examination
- Certified Internet Web (CIW) Network Technology Associate Examination
- Certified Internet Web (CIW) Social Media Strategist Examination
- Certified Internet Web (CIW) User Interface Designer Examination
- Certified Internet Web (CIW) Web Design Specialist Examination
- Certified Internet Web (CIW) Web Security Specialist Examination
- Cloud Essentials Certification Examination
- College and Work Readiness Assessment (CWRA+)
- Computer Maintenance Technology Examination
- Computer Networking Fundamentals Assessment
- Computer Repair Technology Assessment
- Computer Technology Assessment
- Cyber Forensics Associate Examination
- Ethical Hacking Associate Examination
- IC3 Digital Literacy Certification Examination
- Internetworking Examination
- IT Fundamentals+ Certification Examination
- Linux+ Certification Examination
- Microsoft 365 Fundamentals Examination
- Microsoft Certified Azure Fundamentals Examination
- Microsoft Dynamics 365 Fundamentals Examination
- Microsoft Office Specialist (MOS) Examinations
- Microsoft Technology Associate (MTA) Examinations
- National Career Readiness Certificate Assessment
- Network Administration Certification Tests
- Network Pro Certification Examination
- Network+ Certification Examination
- Oracle Certified Associate Examinations
- Oracle Certified Junior Associate Examinations
- PC Pro Certification Examination
- Security Pro Certification Examination
- Security+ Certification Examination
- Technical Support Certification Tests
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.

- Computer Information Systems (6612/36 weeks)
- Computer Information Systems (6614/18 weeks)
- Computer Information Systems, Advanced (6613/36 weeks)
- Computer Information Systems, Advanced (6615/18 weeks)
- Computer Network Software Operations, Advanced (6651/36 weeks)
- Cybersecurity Fundamentals (6302/36 weeks)
- Cybersecurity Operations, Advanced (6306/36 weeks)
- Database Design and Management (Oracle) (6660/36 weeks)
- Design, Multimedia, and Web Technologies (6630/36 weeks)
- Design, Multimedia, and Web Technologies (6632/18 weeks)
- Digital Applications (6611/36 weeks)
- Digital Applications (6617/18 weeks)
- Information Technology Fundamentals (6670/36 weeks)
- International Baccalaureate Information Technology in a Global Society (IB6613/36 weeks)
- Java Programming (Oracle) (6661/36 weeks)
- Office Administration (6621/36 weeks)
- Office Administration (6622/18 weeks)
- Programming (6640/36 weeks)
- Programming, Advanced (6641/36 weeks)

### Career Cluster: Information Technology

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
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<tbody>
<tr>
<td>Information Support and Services</td>
<td>Computer Support Specialist</td>
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<tr>
<td></td>
<td>Database Administrator</td>
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<tr>
<td></td>
<td>Internet Entrepreneur</td>
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<td></td>
<td>Maintenance Technician</td>
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<tr>
<td>Network Systems</td>
<td>Computer and Information Systems Administrator</td>
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<tr>
<td></td>
<td>Computer Support Specialist</td>
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<tr>
<td></td>
<td>Network and Computer Systems Administrator</td>
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<tr>
<td></td>
<td>Telecommunications Specialist</td>
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<tr>
<td>Programming and Software Development</td>
<td>Computer Software Engineer</td>
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<td></td>
<td>Programmer</td>
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<td></td>
<td>Software Applications Engineer</td>
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<td></td>
<td>Software Test Engineer</td>
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<td>Systems Analyst</td>
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</tbody>
</table>

### Career Cluster: Science, Technology, Engineering and Mathematics

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
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</thead>
<tbody>
<tr>
<td>Engineering and Technology</td>
<td>Computer Hardware Engineer</td>
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<tr>
<td></td>
<td>Computer Programmer</td>
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<tr>
<td></td>
<td>Computer Software Engineer</td>
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<td></td>
<td>Network and Computer Systems Administrator</td>
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<tr>
<td></td>
<td>Network Systems and Data Communication Analyst</td>
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<td></td>
<td>Production, Planning, Expediting Clerk</td>
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<td>Project Manager</td>
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<td></td>
<td>Stockroom, Warehouse, or Storage Yard Stock Clerk</td>
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<tr>
<td></td>
<td>Technical Writer</td>
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<tr>
<td></td>
<td>Telecommunications Specialist</td>
</tr>
<tr>
<td></td>
<td>Transportation Manager</td>
</tr>
</tbody>
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