Information Technology Services Occupational Cluster

Information Support Services & Networking Framework (VISSN)

Strand 1: Safety and Health Knowledge and Skills

1.A **Fundamentals of Health and Safety**

1.A.01 Describe and apply health and safety regulations.

1.A.01.01 Identify, describe and apply health and safety regulations that apply to specific tasks and jobs. Students must complete a safety credential program, e.g., Occupational Safety and Health Administration 10, CareerSafe and ServSafe.

1.A.01.02 Identify, describe and apply Environmental Protection Agency (EPA) and other environmental protection regulations that apply to specific tasks and jobs in the specific occupational area.

1.A.01.03 Identify, describe and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the specific occupational area.

1.A.01.04 Explain procedures for documenting and reporting hazards to appropriate authorities.

1.A.01.05 Identify and describe potential consequences for non-compliance with appropriate health and safety regulations.

1.A.01.06 Identify and list contact information for appropriate health and safety agencies and resources.

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1. A.01 Performance Examples:
- List and define OSHA Health and Safety Regulations, EPA and other environmental protection regulations to occupational area.
- List and define Right-to-Know regulations and reporting of hazards and contact information for appropriate health and safety agencies.
- List the laws and rules of regulatory agencies governing sanitation and safety.
- Utilize OSHA as well as health and safety websites for purposes of research.

1.A.02 Demonstrate appropriate health and safety practices based on the specific occupational area.

1.A.02.01 Identify, describe and demonstrate the effective use of Safety Data Sheets (SDS).

1.A.02.02 Read and interpret chemical, product and equipment labels to determine appropriate health and safety considerations.

1.A.02.03 Identify, describe and demonstrate personal, shop and job site safety practices and procedures.

1.A.02.04 Demonstrate safe dress and use of relevant safety gear, personal protective equipment (PPE) and ergonomics, e.g., wrist rests, adjustable workspaces, equipment, gloves, proper footwear, earplugs, eye protection and breathing apparatus.

1.A.02.05 Demonstrate appropriate safe body mechanics, including appropriate lifting techniques and ergonomics.

1.A.02.06	Locate emergency equipment, first aid kit, SDS information directories and emergency action/response plan/escape routes in your lab, shop and classroom, including labels and signage that follow OSHA Hazard Communication Program (HAZCOM), eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches and emergency exits.
1.A.02.07	Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop and classroom, e.g., the OSHA Lockout/Tagout Program (LOTO).
1.A.02.08	Describe safety practices and procedures to be followed when working with and around electricity, e.g., ground fault circuit interrupter (GFCI) and frayed wiring.
1.A.02.09	Handle, store, dispose of and recycle hazardous, flammable and combustible materials, according to EPA, OSHA and product specifications.
1.A.02.10	Demonstrate appropriate workspace cleaning, sanitation, disinfection and sterilization procedures required in specific occupational areas, e.g., Workplace Housekeeping OSHA Regulations.

1. A.02 Performance Examples:
- Identify, describe and demonstrate the use of SDS.
- List and demonstrate shop dress code, safety procedures and location of emergency equipment in labor classroom.
- Define and demonstrate safe storage and maintenance of equipment and proper disposal or recycling of hazardous, flammable and combustible materials.
- Identify, describe and demonstrate the Universal Precautions set of guidelines.

1.A.03	Demonstrate appropriate responses to situations that may threaten health and safety.
1.A.03.01	Describe First Aid procedures for potential injuries and other health concerns in the specific occupational area.
1.A.03.02	Describe the importance of emergency preparedness and an emergency action/response plan.
1.A.03.03	Describe procedures used to handle emergency situations, defensive measures and accidents, including identification, reporting, response, evacuation plans and follow-up procedures.
1.A.03.04	Identify, describe and demonstrate safety practices in specific occupational areas used to avoid accidents.
1.A.03.05	Identify and describe fire protection, protection, precautions and response procedures.
1.A.03.06	Discuss the role of the individual and the company/organization in ensuring workplace safety including transportation to and from school, school activities and the workplace.
1.A.03.07	Discuss ways to identify, prevent and report school and workplace violence, discrimination, harassment and bullying.
1.A.03.08	Demonstrate positive and appropriate behavior that contributes to a safe and healthy environment in school and the workplace.

1. A.03 Performance Example:
- Define first aid procedures and protocols used to handle emergency situations and practices used to avoid accidents.
- View safety videos and discuss the role of workplace safety.
- Attend or participate in a human rights alliance organization presentation.
- Observe and/or demonstrate the appropriate use of a fire extinguisher using the (PASS) technique: Pull, Aim, Squeeze, Sweep.
- Review and discuss specific policies, procedures and protocols regarding discrimination, harassment and bullying.
- Discuss and/or role-play proper and respectful behavior that contributes to a positive climate.
- Discuss and/or demonstrate behavior that contributes to a collaborative/teamwork environment.

Selected Websites

- Bullying Prevention and Intervention Resources : www.doe.mass.edu/bullying
- Centers for Disease Control and Prevention: www.cdc.gov
- Environmental Protection Agency : www.epa.gov
- "Lost Youth – Four Stories of Injured Young Workers"– WorkSafeBC: http://www2.worksafebc.com/Publications/Multimedia/Videos.asp?reportid=34291
- Massachusetts Department of Elementary and Secondary Education. (2011). Career/Vocational Technical Education Safety Guide: www.doe.mass.edu/cte
- Massachusetts Department of Elementary and Secondary Education: www.doe.mass.edu
- Massachusetts Emergency Management Agency: www.mass.gov/eopss/agencies/mema
- Massachusetts General Law: www.malegislature.gov
- Massachusetts Health and Human Services: www.mass.gov/dph
- Massachusetts Right to Know Law Summary: http://www.mass.gov/lwd/docs/dos/mwshp/hib397.pdf
- Safety Data Sheet: www.sdsonline.com
- National Fire Protection Association: www.nfpa.org
- Protection of Student Rights: Massachusetts General Law: https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXII/Chapter76/Section5
- Occupational Safety and Health Administration: www.osha.gov
- Readiness and Emergency Management for Schools: www.rems.ed.gov
- Safe and Healthy Learning Environments: www.doe.mass.edu/ssce/safety.html

Strand 2: Technical Knowledge and Skills

2.A   Information Support Services Safety Knowledge and Operational Procedures

    2.A.01   Demonstrate appropriate use of safety procedures and tools.

        2.A.01.01   Explain the dangers of Electrostatic Discharge (ESD).

        2.A.01.02   List the tools to protect against ESD.

        2.A.01.03   Demonstrate appropriate use of ESD safety tools.

        2.A.01.04   Implement personal safety and Occupational Safety and Health Administration (OSHA) guidelines.

> **2.A.01   Performance Example:**
> - Students will demonstrate the appropriate use of ESD safety tools (ex: wrist strap, anti-static bags, and proper work space) following safe handling and storage methods for computer components according to current industry and OSHA standards.

    2.A.02   Describe environmental impacts and the purpose of environmental controls.

        2.A.02.01   Use Material Safety Data Sheet (SDS) and manufacturer's recommendations for handling, protection and disposal of components and materials.

        2.A.02.02   Monitor temperature, humidity level awareness and proper ventilation.

        2.A.02.03   Identify devices and procedures to protect against power surges, brownouts, blackouts.

        2.A.02.04   Demonstrate protection from airborne particles, dust and debris.

> **2.A.02   Performance Example:**
> - Given a hazardous chemical such as isopropyl alcohol, students will research and print out SDS documentation. Identify proper safety controls for handling, and storing the chemical.

    2.A.03   Practice proper communication and professionalism.

        2.A.03.01   Use proper language – avoid jargon, acronyms, and slang when applicable.

        2.A.03.02   Set and meet expectations/timeline and communicate status with the customer.

        2.A.03.03   Deal appropriately with customers concerning attitude, cultural sensitivity, punctuality, difficult situations and confidential materials.

> **2.A.03   Performance Example:**
> - Given a network helpdesk support scenario, students will demonstrate appropriate communication and professionalism in email communication with the customer.

    2.A.04   Describe fundamentals of dealing with prohibited content/activity.

        2.A.04.01   Outline steps of first response identification, reporting and data preservation.

        2.A.04.02   Explain use of documentation/documentation changes.

        2.A.04.03   Describe the chain of custody process with regards to managing evidence.

2.B   Trends in the Information Technology Workplace and Society

> **2.A.04   Performance Example:**
> - Students will create an electronic flowchart for handling digital evidence.

    2.B.01   Describe the evolution of technology.

        2.B.01.01   Illustrate the information technology (IT) timeline (evolution).

        2.B.01.02   Describe the impact of technologies on society.

        2.B.01.03   Identify technologies and describe their uses in the workplace and society.

2.B.01.04   Illustrate uses of interactive media in society/industry.

2.B.01   Performance Examples:
- Students will create an electronic presentation/timeline that shows the evolution of technology advancements in the IT field and how it has impacted society today.
- Students will create a tri-fold presentation of industry related certifications and highlight three different career pathways in the IT field.
- Students will research IT credentialing options. Students will choose a certification that interests them; then create a pathway for achieving this goal to place in their portfolio.
- Students will record in an electronic journal for one week as a young person who lives in a given year in history. Students will reflect on the types of technology (not just computers) that are in their everyday life now and how its absence would change how they live.
- Students will write an essay on "What would the world be like today if computers didn't exist". How would they spend their time? What would the work look like in the areas of communication, economy, education, family life, community?
- After choosing any occupation other than the IT field, students will research the types of technologies that are used in that field (not just computers per se). Students will present their findings in creative ways e.g. a recruitment program for a college or business, a website, a "day in the life," a story or a play.
- Students will research a company's usage of RSS feeds, Facebook, Twitter, and other types of social media. Create an electronic presentation or podcast highlighting the importance of interactive media on the chosen company/business.

2.B.02   Describe the varied career paths in information technology.
    2.B.02.01   Identify and list professional certifications.
    2.B.02.02   Identify and describe the various IT career paths.

2.C   Computer Hardware
2.C.01   Configure Basic Input Output System (BIOS) Settings.
    2.C.01.01   Identify and configure BIOS settings.
    2.C.01.02   Install firmware upgrades.
    2.C.01.03   Use built-in diagnostics and monitoring.

2.C.01   Performance Examples:
- Students will configure the BIOS to boot from various media devices (optical drive, USB, network, floppy, etc.).
- Students will identify the BIOS manufacturer, version and year.
- Clear all of the BIOS settings using the CMOS jumper on the motherboard

2.C.02   Describe motherboard components.
    2.C.02.01   Identify and describe the purpose of all motherboard components (e.g., socket types, expansion slots, ports, bus speed, random access memory (RAM) slots, chipsets, connectors and jumpers).
    2.C.02.02   Classify various form factors.
    2.C.02.03   Install various motherboards in appropriate chassis.

2.C.02   Performance Examples:
- Given a motherboard, students will create a drawing that accurately illustrates the motherboard and label and briefly describe all of the components.
- Students will create a chart that compares and contrasts the advantages and disadvantages of two or more form factors.

2.C.03   Describe and install various random access memory (RAM) types.
    2.C.03.01   Compare and contrast different RAM types.

| | 2.C.03.02 | Distinguish between RAM compatibility and speed. |
| 2.C.03 | 2.C.03.03 | Install and test various RAM types. |

2.C.03	Performance Examples:
	▪ Using a software diagnostic tool, students will determine the type of RAM installed in a computer.
	▪ Given a particular motherboard model, students will determine the type and maximum amount of RAM that is compatible with the motherboard.
	▪ Using safety tools, (static strap) students will install and test RAM.

2.C.04 **Install expansion cards.**
2.C.04.01 Differentiate between different expansion card types.
2.C.04.02 Configure and install appropriate device drivers and software for optimal operation.

2.C.04	Performance Examples:
	▪ Given a motherboard, students will identify the available expansion slot types.
	▪ Students will install and configure an expansion card such as a video card, sound card or network interface card (NIC).

2.C.05 **Install storage devices and media.**
2.C.05.01 Identify storage devices, their connection types and cables.
2.C.05.02 Install and configure storage devices and media.
2.C.05.03 Demonstrate the appropriate use of media.
2.C.05.04 Describe redundant array of independent disk (RAID) types.

2.C.05	Performance Examples:
	▪ Students will install, configure and test a digital video disc-rewritable (DVD-RW) optical drive.
	▪ Students will install and configure a primary and secondary Serial Advanced Technology Attachment (SATA) hard disk drive in a computer.
	▪ Students will install an external hard disk drive and generate a data backup.

2.C.06 **Differentiate among various central processing unit (CPU) types and corresponding cooling devices.**
2.C.06.01 List types and features of CPUs and their socket types.
2.C.06.02 Choose appropriate CPU for various motherboards.
2.C.06.03 Install CPUs and appropriate coolers.

2.C.06	Performance Examples:
	▪ Students will create a chart that shows the differences between Intel processors and their AMD equivalent.
	▪ Students will install a CPU on a motherboard; apply thermal paste and appropriate coolers.

2.C.07 **Install power supplies.**
2.C.07.01 Determine power supply characteristics and specifications for types of voltage and power.
2.C.07.02 Select and install the proper power supply.

2.C.07	Performance Examples:
	▪ Students will identify the different connectors on a power supply and list examples of their usage.
	▪ Students will install and verify functionality of a power supply in a computer chassis; connect power cables to corresponding motherboard and internal components.

2.C.08   Develop customer specification and needs.
    2.C.08.01   Evaluate customer needs.
    2.C.08.02   Select appropriate components and software for a customer configuration (i.e., CAD workstation, audio/video editing pc, home server, gaming pc, thin client).

2.C.08	Performance Example:
	▪ Given a variety of user types (gamer, video production, musician, etc.), students will specify a computer configuration that would fulfill the user's requirements.

2.C.09   Evaluate characteristics of display devices.
    2.C.09.01   Identify different types of display devices, their connection types and cables.
    2.C.09.02   Define refresh rates, resolution, native resolution, brightness/lumens.
    2.C.09.03   Explain the use of analog vs. digital, privacy/antiglare filters and multiple displays.

2.C.09	Performance Examples:
	▪ Students will install and configure multiple displays on a given workstation.
	▪ Students will use the Microsoft DirectX Diagnostic Tool to analyze graphic display attributes of a system.

2.C.10   Set up peripheral devices.
    2.C.10.01   Install and configure input, output and multimedia devices.

2.C.10	Performance Example:
	▪ Students will install and configure a sound card using updated device drivers, testing functionality with speakers, headset and microphone.

2.D   Laptops
2.D.01   Configure laptop hardware and components.
    2.D.01.01   List and characterize expansion options.
    2.D.01.02   Install and configure hardware/device replacement components.
    2.D.01.03   Compare and contrast laptop display components including WIFI antenna, inverter and backlight.

2.D.01	Performance Examples:
	▪ Given a particular laptop mode, students will identify all user replaceable parts (e.g. memory, RAM, battery, hard drive) and determine capacity and pricing.
	▪ Students will replace and/or upgrade RAM in a laptop.

2.D.02   Compare and contrast laptop features.
    2.D.02.01   Identify special function keys, physical laptop lock and cable lock.
    2.D.02.02   Compare and contrast laptop docking station vs. port replicator.

2.D.02	Performance Example:
	▪ Students will install a laptop in a docking station or port replicator; connect several peripheral devices via the docking station or port replicator verifying functionality of the peripherals.

2.E   Printers
2.E.01   Summarize printer types, installation and maintenance.
    2.E.01.01   Explain the differences between the various printer types.
    2.E.01.02   Summarize the associated imaging process for each type of printer.

2.E.01.03   Install and configure various printers with appropriate cables and printer drivers.

2.E.01.04   Perform printer maintenance.

2.E.01 Performance Example:
- Students will install and test an all-in-one printer/scanner/copier with specified data cable and install accurate device drivers and software needed for full functionality.

2.F   Desktop Operating Systems

2.F.01   Explain features and requirements of popular Desktop Operating Systems.

    2.F.01.01   Compare and contrast current Operating Systems (OS) and their features.

    2.F.01.02   Select the appropriate OS for a 32-bit or 64- bit environment.

    2.F.01.03   Illustrate operating system upgrade paths.

2.F.02   Install and configure Operating Systems using the most appropriate method.

    2.F.02.01   Identify boot methods.

    2.F.02.02   Differentiate among available OS installation methods.

    2.F.02.03   Partition the hard drive.

    2.F.02.04   Format a hard drive using the appropriate file system.

    2.F.02.05   Select suitable setting for operating system customization.

    2.F.02.06   Install drivers, software and OS updates.

2.F.02 Performance Example:
- Students will install an Operating System on a workstation via Universal Serial Bus (USB) and digital video disk (DVD) media.

2.F.03   Utilize appropriate operating system features and tools.

    2.F.03.01   Demonstrate the use of built in operating system features and tools (administrative, disk management, run line commands) and how to access through appropriate paths.

    2.F.03.02   Explore different utilities within control panel/system tools/system settings.

    2.F.03.03   Configure local network settings.

    2.F.03.04   Use OS command line tools.

2.F.03 Performance Example:
- Students will use commands to view, navigate, copy, move, rename, create and delete directories/files using the command line interface.

2.F.04   Perform preventive maintenance procedures using appropriate tools.

    2.F.04.01   Implement best practices (schedule backups, check disks, defrag, updates, patch management, driver/firmware updates and antivirus updates).

    2.F.04.02   Utilize tools for backup, system restore, check disk, recovery image, and defrag.

2.F.04 Performance Examples:
- Students will create a one-year maintenance schedule for a desktop that utilizes essential maintenance tools.
- Students will perform a successful backup.
- Students will create a system restore disk.
- Students will create a password recovery disk.

2.F.05   Explain the differences among basic OS security settings.
    2.F.05.01   Create users and groups.
    2.F.05.02   Compare new technology file system (NTFS) vs. share permissions.
    2.F.05.03   Share files and folders.
    2.F.05.04   Identify system files and folders.
    2.F.05.05   Explain the process of local user authentication.

2.F.05   Performance Examples:
- Students will create a flowchart that explains the process of user authentication.
- On a small peer to peer network, students will create and test shared folders allowing for some and all users to view, edit and save.

2.F.06   Explain the basics of client-side virtualization.
    2.F.06.01   Discuss the purpose of virtual machines.
    2.F.06.02   Assess virtual client requirements.
    2.F.06.03   Define virtual machine managers (e.g. Hypervisor).

2.F.06   Performance Example:
- Students will install virtual pc software on a workstation on a given network.

2.G   Security
2.G.01   Describe common prevention methods.
    2.G.01.01   Describe physical and digital security techniques.
    2.G.01.02   Explain user education and the principle of least privilege.

2.G.01   Performance Example:
- Students will install and test a biometric authentication device on a laptop or desktop.

2.G.02   Compare and contrast common security threats.
    2.G.02.01   Differentiate between social engineering, malware, rootkits, phishing, shoulder surfing, spyware and viruses.

2.G.02   Performance Examples:
- Students will research the most common security threats.
- Students will create an electronic presentation summarizing the security threats and highlighting the preventative measures that could be taken on the workstation.

2.G.03   Implement best practices to secure a workstation.
    2.G.03.01   Create a strong password policy.
    2.G.03.02   Change or disable default user names, accounts and auto-run.

2.G.03   Performance Examples:
- Students will secure a workstation by disabling guest and unknown accounts.
- Students will run a password analyzer program against a list of student created passwords to determine strength in accordance of best practices.

2.G.04   Describe appropriate data destruction/disposal methods.
    2.G.04.01   Compare low level format vs. standard format.
    2.G.04.02   Explain hard drive sanitation methods and physical destruction.

2.G.04	Performance Example:
	▪ Students will research, download and install a low-level format utility program; sanitize a hard drive by running the formatting utility.

2.G.05   Evaluate the methods of network access security.
    2.G.05.01   Summarize the purpose of access control lists (ACLs), port filtering, tunneling and encryption.
    2.G.05.02   Describe site-to-site, client-to-site, and remote access methods.

2.G.05	Performance Example:
	▪ Students will create a presentation/chart comparing the features of site to site, vs. client-to site access/security.

2.G.06   Explain current network user authentication methods.
    2.G.06.01   Test network client authentication.

2.G.06	Performance Example:
	▪ Students will create a flowchart of the Kerberos authentication technique and label the pros and cons of the user authentication method.

2.G.07   Explain common threats, vulnerabilities, and mitigation techniques.
    2.G.07.01   Define common threats and attacks.
    2.G.07.02   Examine mitigation techniques.

2.G.07	Performance Examples:
	▪ Students will research an exploited network.
	▪ Students will describe the vulnerability that the network faced and the mitigation technique that was implemented to secure the network.

2.G.08   Review firewall options.
    2.G.08.01   Differentiate among the types of firewalls.
    2.G.08.02   Describe implementation of firewall rules.
    2.G.08.03   Define key tools such as port security, network address translation (NAT)/PAT, demilitarized zone (DMZ).
    2.G.08.04   Compare stateful inspection vs. packet filtering.
    2.G.08.05   Plan and install a firewall solution.

2.G.08	Performance Example:
	▪ Students will install, configure and test a basic firewall solution, implementing rules for denying traffic, opening ports, etc.

2.G.09   Categorize different types of network security appliances and methods.
    2.G.09.01   Explain the function of intrusion detection system (IDS), intrusion prevention system (IPS) and Vulnerability Scanners.

2.G.09	Performance Example:
	▪ Students will research current network security appliances.
	▪ Students will categorize appliances for small office/home office (SOHO) and Medium Business class networks based upon features, price and scalability.

2.H   Mobile Devices

2.H.01   Explain the basic features of mobile operating systems.
       2.H.01.01   Compare and contrast current mobile Operating Systems and their features.

> 2.H.01   Performance Example:
> - Students will research current mobile operating systems and create a chart differentiating key features between versions.

2.H.02   Establish basic network connectivity and configure email.
       2.H.02.01   Configure wireless, cellular, Bluetooth connectivity.
       2.H.02.02   Configure an email application.

> 2.H.02   Performance Example:
> - Students will configure Microsoft Outlook to work with a free email service.

2.H.03   Secure mobile devices.
       2.H.03.01   Define and describe pass code locks, remote wipes, locator applications, remote backup applications, failed login attempts restrictions.
       2.H.03.02   Distinguish among appropriate antivirus applications and available OS updates and patches.
       2.H.03.03   Install and update mobile OS software.

> 2.H.03   Performance Example:
> - Students will install and update mobile operating system software for a tablet and anti "x" software.

2.H.04   Compare and contrast hardware differences in regards to tablets and laptops.
       2.H.04.01   Identify power consumption optimization techniques.
       2.H.04.02   Demonstrate proper handling, cleaning and docking of tablets and laptops.

> 2.H.04   Performance Examples:
> - Students will install and run applications on a laptop and an adjacent tablet.
> - Students will document performance describing the pros and cons of each mobile hardware option.

2.H.05   Execute and configure mobile device synchronization.
       2.H.05.01   Explain the types and requirements of mobile data synchronization methods.
       2.H.05.02   Synchronize mobile devices.

> 2.H.05   Performance Example:
> - Students will capture images on two mobile devices; share images by synchronizing the devices using available technology (i.e. Bluetooth).

2.I   Networking Concepts

2.I.01   Compare the layers of the Open Systems Interconnection (OSI) and Transmission Control Protocol/Internet Protocol (TCP/IP) models.
       2.I.01.01   Define the purpose of networking models.
       2.I.01.02   Identify the layers of the OSI model.
       2.I.01.03   Identify the layers of the TCP/IP model (i.e., Network Interface Layer, Internet Layer, Transport Layer, and Application Layer).

> 2.I.01   Performance Example:
> - Students will create an electronic presentation/chart comparing the layers of the OSI to the TCP/IP models.

2.I.02   Apply the OSI model.
 2.I.02.01   Classify the differences between Layer 1, Layer 2 and Layer 3 applications, devices, and protocols as they relate to the OSI model layers.

2.I.02	Performance Example:
	▪ In a chart, students will determine if the given device sample, protocol, PDU or application belongs to Layer 1, Layer 2, or Layer 3 of the OSI model.

2.I.03   Explain the purpose and properties of IP Addressing.
 2.I.03.01   Identify the Classes of addresses.
 2.I.03.02   Describe Classless Inter-Domain Routing (CIDR).
 2.I.03.03   Describe the differences between Internet Protocol version 4 (IPv4) vs. Internet Protocol version 6 (IPv6).
 2.I.03.04   Distinguish differences between static and dynamic addressing.
 2.I.03.05   Distinguish differences between public and private addressing.
 2.I.03.06   Explain the components of the TCP/IP protocol including IP, subnet mask and default gateway.
 2.I.03.07   Describe and prepare a subnet.
 2.I.03.08   Differentiate among multicast, unicast and broadcast.
 2.I.03.09   Detect Automatic Private IP Addressing (APIPA).

2.I.03	Performance Examples:
	▪ Students will design an IP scheme for a network and identify the network, broadcast, and host address range for a network.
	▪ Students will apply CIDR and Variable-Length Subnet Masking (VLSM) rules to a large network subnetted into two or more groups by creating IP schemes for each subnet - using both private and public IP.
	▪ Students will create a logical map of your local school's IP address scheme and show how the addresses are divided logically by design.

2.I.04   Explain Dynamic Host Configuration Protocol (DHCP) concepts, describe its components and configure DHCP service.
 2.I.04.01   Explain DHCP client and server side elements (reservations, scopes, leases).
 2.I.04.02   Configure DHCP service.

2.I.04	Performance Examples:
	▪ Students will configure a local computer for DHCP for both wired and wireless adapter cards.
	▪ Students will configure an ISR to be a DHCP server for 25 dynamic nodes (laptops, desktops) and create a reservation for 5 static nodes (printers/servers).

2.I.05   Explain Domain Name System (DNS) concepts, describe its components and install DNS servers.
 2.I.05.01   Evaluate DNS servers, DNS records and Dynamic DNS.
 2.I.05.02   Explain client side DNS.

2.I.05	Performance Examples:
	▪ Students will install a DNS service on a local server or virtual server.
	▪ Using a WHOIS website, students will locate 10 different domains/websites and identify the DNS service.
	▪ Students will record data related to the corresponding DNS service, records, and configuration.

2.I.06　　Explain the function of common networking protocols, associated port numbers and their purpose.

　　　　2.I.06.01　　Identify common Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) default ports.

　　　　2.I.06.02　　Define common network protocols.

2.I.06	Performance Example:
	▪ Students will research the six most common TCP and UDP ports and their associated applications and prepare a report summarizing their findings.

2.I.07　　Explain the purpose and properties of routing and switching.

　　　　2.I.07.01　　Differentiate between Interior Gateway Protocol (IGP) and Exterior Gateway Protocol (EGP).

　　　　2.I.07.02　　Compare routing protocols (i.e. link state vs. distance vector vs. hybrid, static vs. dynamic, routing metrics, next hop).

　　　　2.I.07.03　　Explain Spanning-Tree Protocol, Virtual Local Area Network (VLAN) & port mirroring and convergence (steady state) concepts.

　　　　2.I.07.04　　Distinguish between a broadcast domain and a collision domain.

　　　　2.I.07.05　　State the function of routing and switching tables.

2.I.07	Performance Examples:
	▪ With the given information, students will determine how a switch forwards a frame based on the source MAC and destination MAC addresses and information in the switch MAC table.
	▪ Given a network diagram, students will determine the number of collision and or broadcast domains.

2.I.08　　Identify and describe virtual network components.

　　　　2.I.08.01　　Identify and describe virtual switches, virtual desktops, virtual servers, virtual private branch exchange (PBX).

　　　　2.I.08.02　　Compare onsite vs. offsite virtualization.

　　　　2.I.08.03　　Install a virtual network.

2.I.08	Performance Examples:
	▪ Students will install a virtual machine using benchmark software.
	▪ Students will compare an operating system on a virtual client vs. a local client and benchmark performance for various tasks (open large images; copy files from one location to another).

2.I.09　　Compare and contrast wireless networking standards and encryption types.

　　　　2.I.09.01　　Categorize wireless standards 802.11 a/b/g/n speeds, distances and frequencies.

　　　　2.I.09.02　　Describe various wireless encryption types.

2.I.09	Performance Examples:
	▪ Students will create an electronic chart comparing the 802.11 wireless standards for speed, distance limitations and frequencies.
	▪ Given a network scenario, students will select the appropriate wireless encryption type.

2.J　　Network Media and Topologies

2.J.01　　Describe the characteristics of network cables and associated connectors, prepare and install network cabling.

2.J.01.01	Identify fiber cable and connector types.
2.J.01.02	Identify copper cable types (Twisted Pair and Coaxial) and associated connector types.
2.J.01.03	Compare the speed and transmission limitations of various network cables.
2.J.01.04	Describe plenum and non-plenum ratings and the use of broadband over power lines.
2.J.01.05	Install and terminate network cabling.

2.J.01	Performance Examples:
	▪ Students will terminate and test UTP cables for straight -through and cross over configurations.
	▪ Students will run UTP cable for a basic network data drop, terminate cable at the wall (RJ45 female) and patch panel termination points.

2.J.02	Identify components of wiring distribution and management.
2.J.02.01	Define and describe IDF, MDF, Demarc and CSU/DSU.
2.J.02.02	Explain the purpose of cable management.
2.J.02.03	Explain the value of network maps and documented wiring schematics.

2.J.02	Performance Examples:
	▪ Student will tour and review the school's network, identify and list the MDF and IDF closets and Demarc location.
	▪ Using diagramming software, Students will illustrate physical/logical topology of a given network cabling and wiring closet scheme and differentiate the closets and cable types using different colors (ex: red to signify fiber cable, blue to signify CAT5/6 cable, green to signify other types of connections such as coaxial).

2.J.03	Compare and contrast internet connection types and features.
2.J.03.01	Identify properties of common SOHO Internet connection types (Cable, DSL, Dial-up, Fiber, and Satellite).
2.J.03.02	Identify properties of typical business Internet connection types (ISDN, Frame Relay, ATM,T1, T3, DS3, Sonnet OCx).
2.J.03.03	Differentiate among wireless Internet connection types (Cellular/mobile hot spot, line of sight wireless internet service, WiMAX).

2.J.03	Performance Examples:
	▪ Students will research current SOHO Internet service provider (ISP) options and compare student's home network contracts to current offerings.
	▪ Students will verify guaranteed speeds in the contract along with additional features of service.
	▪ Students will create an electronic tutorial detailing the speeds, features and common placement of typical business Internet connections.

2.J.04	Categorize various network types and topologies.
2.J.04.01	Differentiate among LAN, WAN, PAN, MAN, WLAN, and WWAN.
2.J.04.02	Explain the Ethernet 802.3 standards.
2.J.04.03	Describe CSMA/CD and CSMA/CA.
2.J.04.04	Compare and contrast physical vs. logical topologies.
2.J.04.05	Describe ring, bus, star, extended star & mesh topologies.
2.J.04.06	Describe Peer-to-peer, Client-server, Hybrid, Point to point, Point to

2.J.04	Performance Examples:
	▪ Using diagram software, students will diagram a network's physical and logical topology.
	▪ Students will illustrate or build a model of a network topology type (ex: bus, star, mesh).
	▪ While reading/reviewing a network diagram, students will determine how the network device handles a packet in a given scenario.

multipoint and MPLS topologies.

2.J.05   Compare and contrast network devices, their functions and their features.
　　2.J.05.01   Differentiate the functionality of hubs, switches, bridges, routers, access points, and modems.
　　2.J.05.02   Explain the function of firewalls, network access server (NAS) and Voice over Internet Protocol (VoIP) phones.

> 2.J.05   Performance Examples:
> - Given a network diagram, students will determine where to place a firewall solution.
> - Students will narrate a podcast or interactive presentation that describes the functionality and differences among hubs, switches, bridges, routers, access points and modems.

2.K   Network Installation and Configuration
2.K.01   Install and configure network operating systems.
　　2.K.01.01   Identify common network operating systems.
　　2.K.01.02   Install a network operating system.
　　2.K.01.03   Configure a server.

> 2.K.01   Performance Examples:
> - Students will install a network operating system and prepare server for client authentication using Dynamic Host Configuration Protocol (DHCP) services and network printing services.
> - Students will configure a File Transfer Protocol (FTP) server.

2.K.02   Plan a basic SOHO network.
　　2.K.02.01   Create a list of hardware, software and infrastructure requirements for implementation.
　　2.K.02.02   Review environment and equipment limitations and system compatibility requirements.
　　2.K.02.03   Determine equipment placement.
　　2.K.02.04   Illustrate the network.

> 2.K.02   Performance Example:
> - Students will illustrate a common SOHO network per a given client scenario.

2.K.03   Install, configure, and deploy a secure SOHO wireless/wired network using best practices.
　　2.K.03.01   Access and configure wireless/wired ISR for a basic SOHO network.
　　2.K.03.02   Configure options for MAC filtering, port forwarding/triggering, Service Set Identifier (SSID) broadcast, and wireless encryption.
　　2.K.03.03   Enable/disable services such as firewall, DHCP, DMZ, NAT, & WPS.
　　2.K.03.04   Disable unused ports.

> 2.K.03   Performance Example:
> - Students will configure an ISR per a given client scenario, enabling MAC filtering, port forwarding and wireless encryption.

2.L   Network Management
2.L.01   Identify components of network management.
　　2.L.01.01   Explain the purpose and features of various network appliances.
　　2.L.01.02   Explain the different methods and rationales for network performance optimization.
　　2.L.01.03   Explain the purpose of network monitoring resources to analyze traffic.

2.L.01.04   Describe the purpose and benefit of configuration management documentation.

2.L.01   Performance Examples:
- Given a scenario, students will build a server rack using diagramming software to house various network appliances and label their role on the network.
- Students will create an account using a single sign on service (ex: Google Login/Windows Live) to demonstrate single sign on privileges and access.
- Students will download a free packet sniffer software package; install sniffer on a basic LAN; generate traffic to capture packets; and open and view captured packets.
- Working in teams, students will create a network map of a functional LAN and document all configurations, addressing scheme, etc. Students will re-create the network of alternative team based upon network documentation.

2.M   Troubleshooting

2.M.01   Explain the troubleshooting theory.

     2.M.01.01   Identify the IT related problem.

     2.M.01.02   Establish a theory of probable cause (question the obvious) using common symptoms.

     2.M.01.03   Test the theory to determine cause using diagnostic tools.

     2.M.01.04   Establish a plan of action to resolve the problem and implement the solution.

     2.M.01.05   Verify full system functionality and, if applicable, implement preventive measures.

     2.M.01.06   Document findings, actions and outcomes.

2.M.01   Performance Example:
- Students will review and analyze several universal troubleshooting approaches and create their own personal troubleshooting theory.

2.M.02   Troubleshoot common problems related to motherboards, RAM, CPU and power with appropriate tools.

2.M.02   Performance Examples:
- Students will determine a variety of hardware problems, repair or replace the components and test the solutions.
- Students will solve a variety of software problems using appropriate diagnostic utilities, apply appropriate repair techniques, and test the solutions.
- Students will use problem solving strategies and diagnostic tools to identify network problems.

2.M.03   Troubleshoot hard drives and RAID arrays with appropriate tools.

2.M.04   Troubleshoot common video and display issues.

2.M.05   Troubleshoot operating system problems with appropriate tools.

2.M.06   Troubleshoot common local computer security issues with appropriate tools and best practices.

2.M.07   Troubleshoot and repair common laptop issues while adhering to the appropriate procedures.

2.M.08   Troubleshoot printers with appropriate tools.

2.M.09   Troubleshoot wired and wireless networks with appropriate tools.

2.M.10   Troubleshoot common physical connectivity problems.

2.M.11   Identify and correct IP addressing issues.

2.M.12   Select appropriate hardware tools to troubleshoot connectivity issues.

2.M.13   Select appropriate software tools to troubleshoot connectivity issues.
      2.M.13.01   Install software and hardware tools, protocol analyzer, throughput testers and connectivity software.
      2.M.13.02   Demonstrate common troubleshooting command line tools (Ping, Tracert/traceroute, Dig, Ipconfig/Nslookup, ArpNbtstat, Netstat).

2.N   Applications
2.N.01   Identify the function of various local and network applications.
      2.N.01.01   Categorize applications by type and use.
2.N.02   Install applications.
      2.N.02.01   Install, configure and test local and network applications.
      2.N.02.02   Install, configure and test internet browser packages.
      2.N.02.03   Uninstall applications.
      2.N.02.04   Acquire and verify software licensure.
      2.N.02.05   Identify steps to perform an upgrade and determine compatibility issues.
      2.N.02.06   Retrieve, install and test application patches, updates and service packs.

2.O   Multimedia and Graphic Tools
2.O.01   Utilize multimedia and graphic tools.
      2.O.01.01   Describe various interactive media tools.
      2.O.01.02   Create and manipulate images using a graphic drawing/editing program.
      2.O.01.03   Import and export graphics using external peripherals.
      2.O.01.04   Differentiate between digital image, audio and video file formats.
      2.O.01.05   Open, run and create video clips.
      2.O.01.06   Play and record sound clips.

2.P   Programming Concepts
2.P.01   Explain the purpose and functions of computer programming.
      2.P.01.01   Describe what a computer program is and how it runs.
      2.P.01.02   Identify and list various types of current programming languages.
      2.P.01.03   Explain the steps in a program life cycle.
      2.P.01.04   Design a simple program for a specific application.
      2.P.01.05   Create, test functionality, debug and document a simple computer program.
      2.P.01.06   Describe and apply database concepts.
      2.P.01.07   Give examples of database queries and data reports.
      2.P.01.08   Create a custom database.

> 2.P.01   Performance Example:
> - Students will create a custom database from a given set of guidelines.

2.Q   Web Page Development
2.Q.01   Explain the fundamentals of web page development.
      2.Q.01.01   Describe the methods of creating web sites.
      2.Q.01.02   Apply structural requirements (information architecture) for development of a web site.
      2.Q.01.03   Create a web site, using web site design software or programming language.
      2.Q.01.04   Apply web site design features.
      2.Q.01.05   Create hyperlinks.
      2.Q.01.06   Proofread, edit and test a web site.
      2.Q.01.07   Explain and demonstrate publishing, updating, and maintaining a web site.
      2.Q.01.08   Describe methods for achieving web site recognition.
      2.Q.01.09   Critique a web site according to accepted web site design principles.

2.R*   Advanced Routing and Switching
  2.R.01*   Implement a switched network.
      2.R.01.01*   Select the appropriate media, cables, ports, and connectors to connect
                    switches to other network devices and hosts.
      2.R.01.02*   Explain the technology and media access control method for Ethernet
                    technologies.
      2.R.01.03*   Explain network segmentation and basic traffic management concepts.
      2.R.01.04*   Explain the operation of network switches and basic switching concepts.
      2.R.01.05*   Perform, save and verify initial switch configuration tasks including remote
                    access management.
      2.R.01.06*   Verify network status and switch operation using basic utilities (including:
                    ping, traceroute, telnet, SSH, arp, ipconfig), SHOW & DEBUG commands.
      2.R.01.07*   Implement and verify basic security for a switch (port security, deactivate
                    ports).
      2.R.01.08*   Identify, prescribe, and resolve common switched network media issues,
                    configuration issues, auto-negotiation, and switch hardware failures.
  2.R.02*   Implement a routed network.
      2.R.02.01*   Describe basic routing concepts (including: packet forwarding, router
                    lookup process).
      2.R.02.02*   Describe the operation of routers (including: router bootup process, POST,
                    router components).
      2.R.02.03*   Select the appropriate media, cables, ports, and connectors to connect
                    routers to other network devices and hosts.
      2.R.02.04*   Configure, verify, and troubleshoot RIPv2.
      2.R.02.05*   Access and utilize the router command line interface (CLI) to set basic
                    parameters.
      2.R.02.06*   Connect, configure, and verify operation status of a device interface.
      2.R.02.07*   Enable NAT for a small network with a single ISP and connection using SDM
                    and verify operation using CLI and ping.
      2.R.02.08*   Configure, verify and troubleshoot DHCP and DNS operation on a router
                    (including: CLI/SDM).
      2.R.02.09*   Perform and verify routing configuration tasks for a static or default route
                    given specific routing requirements.
      2.R.02.10*   Verify device configuration and network connectivity using common
                    utilities.
      2.R.02.11*   Manage router operating system configuration files (including save, edit,
                    upgrade, restore).
      2.R.02.12*   Implement password and physical security for a network router.
      2.R.02.13*   Verify network status and router operation using basic utilities (including:
                    ping, traceroute, telnet, SSH, arp, ipconfig), SHOW & DEBUG commands.
  2.R.03*   Implement and verify WAN links.
      2.R.03.01*   Describe different methods for connecting to a WAN.
      2.R.03.02*   Configure and verify a basic WAN serial connection.
2.S*   Server Management
  2.S.01*   Install and manage servers.

2.S.01.01*   Manage device drivers, including but not limited to, installation; removal; disabling; update/upgrade; rollback; troubleshooting; Plug & Play; IRQ; interrupts; driver signing.

2.S.01.02*   Manage services, including but not limited to, what services are; which state a service can be in; startup types; recovery options; delayed startup; Run As settings for a service; stopping or pausing a service; service accounts, dependencies.

2.S.01.03*   Perform various server installations including, but not limited to, choosing correct OS version; partitioning; F8 options; server core vs. full; interactive install; unattended install; automated install using WDS; upgrade vs. clean install; firmware updates including BIOS

2.S.02*   Implement server roles.

2.S.02.01*   Prepare various types of application servers including, but not limited to, mail servers; database servers; collaboration servers; monitoring servers; threat management.

2.S.02.02*   Configure web services including, but not limited to, IIS, WWW, FTP, separate worker processes, adding components, sites, ports, SSL and certificates.

2.S.02.03*   Utilize remote access including, but not limited to, remote assistance, remote administration tools ,remote desktop services, licensing, remote desktop gateway, VPN, application virtualization, multiple ports.

2.S.02.04*   Configure file and print services including, but not limited to, printer pools; web printing; web management; driver deployment; file, folder, and share permissions vs. rights; auditing; print job management.

2.S.02.05*   Describe server virtualization modes; VHDs; virtual memory; virtual networks; snapshots and saved states; physical to virtual; virtual to physical.

2.S.03*   Manage active directory.

2.S.03.01*   Create accounts and groups.

2.S.03.02*   Structure organizational units and containers.

2.S.03.03*   Describe active directory infrastructure including but not limited to domain controllers, forests, operation master roles, domain vs. workgroup, child domains, trusts, functional levels, namespace, sites, and replication.

2.S.03.04*   Implement group policy.

2.S.04*   Identify storage technologies.

2.S.04.01*   Indicate advantages and disadvantages of different storage technologies; local (SATA, SCSI, IDE); NAS; SAN; fiber channel; iSCSI; NFS; FC HBA and FC switches; iSCSI hardware.

2.S.04.02*   Classify RAID (RAID 0, RAID 1, RAID 5, RAID 10 and combinations; hardware and software RAID).

2.S.04.03*   Identify disk types (ATA; basic disk; dynamic disk; mount points; file systems; mounting a virtual hard disk; distributed file systems; optical disks).

2.S.05*   Manage server performance.

2.S.05.01*   Distinguish among major server hardware components.

2.S.05.02*   Explain performance monitoring (methodology; procedures; effect of network, CPU memory and disk; creating a baseline; perfmon; resmon; task manager; performance counters).

2.S.05.03*   Explain logs and alerts.

2.S.06*   Perform server maintenance.

2.S.06.01*   Identify the steps in the server startup process.
2.S.06.02*   Explain the value of business continuity (i.e., backup and restore, disaster
              recovery and data redundancy).
2.S.06.03*   Manage server updates.