

*Massachusetts Department of Elementary & Secondary Education*

Office for Career/Vocational Technical Education



*Vocational Technical Education Framework*



Information Technology Services Occupational Cluster

***Information Support Services & Networking (VISSN)***

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**Massachusetts Department of Elementary and Secondary Education**

**Office for Career/Vocational Technical Education**

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# Acknowledgements

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## Commissioner's Letter

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# **Massachusetts Department of Elementary and Secondary Education**

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Mitchell D. Chester, Ed.D.  
Commissioner

July 2014

Dear Colleagues,

I am pleased to present to you the *Massachusetts Vocational Technical Education Frameworks*, adopted by the Department of Elementary and Secondary Education in June 2014. These frameworks, one for each of the 44 vocational technical programs, include standards in multiple strands representing all aspects of the industries that students in the vocational technical education program are preparing to enter.

The frameworks also include a crosswalk between the technical standards and relevant standards in Massachusetts Curriculum Frameworks to support effective integration of academic and technical content.

The comments and suggestions received during revision of the 2007 *Massachusetts Vocational Technical Education Frameworks* have strengthened these frameworks. We will continue to work with schools and districts to implement the 2014 *Massachusetts Vocational Technical Education Frameworks* over the next several years, and we encourage your comments.

I want to thank everyone who worked with us to create challenging learning standards for Massachusetts students. I am proud of the work that has been accomplished.

Sincerely,

Mitchell D. Chester, Ed.D.  
Commissioner of Elementary and Secondary Education

# Introduction

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## Overview & Organization and Key Changes

### Overview

The Massachusetts Department of Elementary and Secondary Education understands the necessity of maintaining current Vocational Technical Education Frameworks which ensure career/vocational technical education students across the Commonwealth are taught the most rigorous standards aligned to the needs of business and industry.

With the advent of the Massachusetts Teaching & Learning System the Office for Career/Vocational Technical Education (CVTE) recognized the significance of including career/vocational technical education in the system and developed a comprehensive plan for including vocational technical education. The plan was designed in a Two Phase Process. Phase One included the revision of strands two, three, and six, of all of the Vocational Technical Education Frameworks. Phase Two consisted of three major components (projects) all equally crucial;

1. The revision of Strands One, Four, and Five to complete the revision of all six strands of the Vocational Technical Education Frameworks;
2. Statewide Professional Development on all revised strands, with training on strands two, three, and six delivered fall 2013, and training on strands one, four, and five delivered spring 2014;
3. The creation and development of additional Model Curriculum Unit (MCU) Teams.

The Office for Career/Vocational Technical Education Framework Team, with support from consultants, began Phase One in the 2012-2013 school year, to revise three of the six strands contained in all of the Vocational Technical Education (VTE) Frameworks. The state was organized into “Collaborative Partnerships” comprised of teams of project administrators, highly qualified subject matter educators, and business and industry partners, whose task was to revise Strand Two – Technical, Strand Three – Embedded Academics, and Strand Six – Technology Literacy. Each team met with a vocational advisory committee which included business and industry representatives and postsecondary education professionals, whose mission was to review and revise the team’s draft document during the revisionary process. Once strand two was revised, academic teachers (typically one English Language Arts teacher, one Mathematics teacher, and one Science teacher) worked with the technical subject matter teachers to develop a crosswalk between academic curricula standards and the technical standards, and provided examples of embedded academic content.

The Office for Career/Vocational Technical Education solicited statewide input from technical and academic teachers and administrators at the annual Massachusetts Association of Vocational Administrators (MAVA)/Massachusetts Vocational Association (MVA) - Connecting for Success Conference. Each framework team met with their content colleagues and reviewed the draft revisions and obtained valuable feedback. Additionally, all drafts were reviewed and revised by the Massachusetts Vocational Technical Teacher Testing Program, to ensure appropriate measurable language.

Project consultants designed a new template to ensure all framework teams entered new standards and additional resources in a consistent manner. The framework teams created an “Appendix” listing potential industry recognized credentials attainable by secondary students; lists of professional, student, and relevant government organizations; and useful resources and websites. *\* It is important to note that although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted. Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education.*

The Office for Career/Vocational Technical Education facilitated a comprehensive vetting process throughout the Commonwealth. During the fall of 2012 districts throughout Massachusetts solicited feedback from each Vocational Program’s Advisory Committee members at the Fall Board meetings. Additionally, the Office for Career/Vocational Technical Education met with various licensing boards at the Massachusetts Division of Professional Licensure and provided the applicable draft framework to each board for review. All framework drafts were posted on the CVTE website for public comment. Comments and suggested revisions received were shared with each framework team for response and edits, as appropriate.

The Phase I Process was completed on an accelerated timetable and resulted in all Vocational Technical Education Frameworks; Strand Two and Strand Six, revised with current, rigorous, relevant standards. Strand Three has been redesigned into a crosswalk which directly correlates academic and technical standards. An appendix of useful material for technical teachers recommended by their peers was added to each framework.

Phase II of the Framework Revision Process consisted of three major projects;

1. The Strands One, Four & Five Project, to complete the revision of all six strands of the Vocational Technical Education Frameworks;
2. Statewide Professional Development on all revised strands, with training on strands two, three, and six delivered fall 2013, and training on strands one, four, and five delivered spring 2014;
3. The creation and development of additional Model Curriculum Unit (MCU) Teams.

The Strands One, Four, & Five Project began in the fall of 2013 with the formation of a leadership team and three work groups. Co-Managers led the leadership team comprised of three Strand Coordinators who facilitated work teams and reviewed, researched, and revised these common strands. All skills specific to the vocational technical program have been included into Strand Two Technical.

The Strand One Team revised the safety knowledge and skills that all students need to acquire. The team included relevant issues (i.e., bullying, climate), laws, regulations, guidelines and policies pertaining to safety.

The Strand Four Team revised the Employability Knowledge and Skills that all students need to acquire. Teams considered current research on career readiness, including the work of the College Career Readiness Task Force convened by the Department, changes in workplace, technological changes that impact how people perform their work (i.e., communications methods), and included standards that

emphasize the need for lifelong learning and adaptability given the multiple career changes over and an individual's working life. The team recommended this strand be renamed to: Career Readiness.

The Strand Five Team revised the Management & Entrepreneurship Knowledge and Skills that all students need to acquire. All business owners and employees must possess management and financial skills to be productive members of society. Skills included financial knowledge and basic business management skills.

All Strand One, Four and Five Project Teams worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Massachusetts Career and Technical Student Organizations to crosswalk standards to national Career & Technical Student Organizations Curricula, as applicable.

The Office for Career/Vocational Technical Education contracted the MAVA Consultant Team to work closely with the office to complete all of the work accomplished during Phase II of the Project.

A remarkable amount of work was accomplished through the efforts of hundreds of professionals who collaborated and diligently supported this work. The Office for Career/Vocational Technical Education is grateful for all the support received from the field, particularly all of the teachers (technical and academic), administrators, advisory committee members, business and industry representatives, the Division of Professional Licensure - boards, the Massachusetts Association of Vocational Administrators, the MAVA Consultants, and the Massachusetts Vocational Association, whose contributions were tremendous.

Special thanks to all staff in the Office for Career/Vocational Technical Education and the CVTE Framework Revision Team who provided guidance and numerous contributions during Phase One of the project.

## Organization and Key Changes

This section contains the following:

- Highlights of Changes to the Vocational Technical Education Frameworks; which includes a summary of changes made to each strand.
- Organization of the Frameworks – Strand Two illustrates structure of topic headings, standards and objectives, and performance examples.

### Highlights of Changes to the Vocational Technical Education Frameworks:

#### Strand One:

Safety and Health Knowledge and Skills have been revised to contain the safety standards that are common to all programs. The Strand One Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Career and Technical Student Organizations (CTSO) to crosswalk standards to national CTSO Curricula, as applicable.

- No objectives were deleted, only modified.
- Language and wording was clarified.
- Additions included a focus on maintaining a safe school and workplace in terms of creating a positive climate/environment.
- Student safety credential program has been revised.
- Safety attire has been revised.
- Emergency equipment and fire safety has been revised.
- Many new Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

#### Strand Two:

The Technical Standards Knowledge and Skills have been revised to reflect business and industry changes since the adoption of the 2007 Vocational Technical Education Frameworks (VTEF). There are additional changes to Strand Two below:

- The Technical Knowledge and Skills (Strand Two) section contains standards specific to the particular vocational program; suffix "a" (as common to all programs) and suffix "c" (as common within a cluster) have been removed.
- Each VTEF Strand Two begins with safety and health knowledge and skills specific to the particular vocational program.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

- Strand Two of the Frameworks for Animal Science, Environmental Science and Technology, and Horticulture, begin with core standards required for all participants in the programs, followed by a series of standards organized in concentrations. See the section below titled: “Organization of the Frameworks – Strand Two” for more information.
- An update to some of the vocational programs framework is the addition of advanced or supplemental standards which are noted in Strand Two by an asterisk (\*). *These standards are not required, but are provided as suggestions that districts may choose to use to increase the depth of a particular topic, or add additional topics, particularly for advanced students or for those seniors who do not participate in cooperative education.* See the section below titled: “Organization of the Frameworks – Strand Two” for more information.

### Strand Three:

Since the purpose of Strand Three was to correlate academic content that was *embedded* in the knowledge and skills necessary to perform certain technical skills, it was logical to highlight those connections through a crosswalk between the academic curriculum standards and the technical standards (Strand Two). The crosswalk directly correlates the English Language Arts (2011) and Mathematics (2011) Frameworks, incorporating the Common Core Standards and the Science and Technology/Engineering Frameworks. The crosswalk can be found in the appendix of each vocational framework. The crosswalk also includes performance examples which illustrate integrated academic and technical content.

- Embedded Academics has been replaced with a crosswalk between the academic curriculum standards and the technical knowledge and skills standards. The crosswalk is located in the Appendices.

### Strand Four:

Employability (and Career Readiness) Knowledge and Skills focused on providing students with general knowledge and skills to be college and career ready. The Strand Four Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Career and Technical Student Organizations to crosswalk standards to national CTSO Curricula, as applicable.

- Language and wording were clarified.
- Additions included a focus on providing students with skills for employability/career readiness.
- Modifications included Career Exploration & Navigation, Communication in the Workplace, and Work Ethic & Professionalism.
- New Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: “Organization of the Frameworks – Strand Two”. All strands were organized in that manner, with the exception of the former Strand Three.

### Strand Five:

Strand Five contains Management and Entrepreneurship Knowledge and Skills that are general for all students. The Strand Five Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Massachusetts Career and Technical Student Organizations to crosswalk standards to national Career & Technical Student Organizations Curricula, as applicable.

- Language and wording were clarified and organized into a logical format.
- The Strand Five Team felt that the 2007 curriculum remained valid.
- Additions included a focus on providing students with skills for management and entrepreneurship applicable to all vocational programs.
- Modifications included Starting and Managing a Business, Marketing, and Financial Concepts & Applications in Business, and Legal/Ethical/Social Responsibilities.
- New Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

### Strand Six

Strand Six Technology Literacy Knowledge and Skills has been replaced with the 2008 Massachusetts Technology Literacy Standards and Expectations Framework.

## Appendix<sup>1</sup>

Each framework contains an “Appendix” section which includes an Embedded Academic Crosswalk, Industry Recognized Credentials, Statewide Articulation Agreements, Professional, Governmental, and Student Organizations, Resources, and relevant websites.

The Appendix<sup>2</sup> contains:

- Embedded Academic crosswalks for English Language Arts, Mathematics, and Science & Technology/Engineering.
- Statewide Articulations: Current statewide Articulation Agreements and/or Apprenticeship Programs available to the specific vocational program are listed on this page. The development of new statewide articulations continues, and therefore these pages will be revised as new agreements are finalized.
- Industry-Recognized Credentials: Technical Teacher Teams generated lists of credentials for the vocational programs. Program Advisory Committees throughout the state reviewed and provided recommendations through the validation process. *The credential list has been provided as a resource only and districts are not obligated to provide all of the specified credentials for students.*
- Other: These pages provide lists of reference materials, government agencies, professional and student organizations, and useful websites created by each framework team. These are intended as helpful resources for technical teachers, identified by peers. These are not recommended or required by the Department of Elementary & Secondary Education.

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<sup>1</sup> Note: Although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted.

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## Organization of the Frameworks – Strand Two

The Vocational Technical Education Frameworks contain knowledge and skills covering all aspects of industry, reflected in six strands: Safety and Health, Technical, Embedded Academics, Employability, Management and Entrepreneurship, and Technological.

Within each strand, standards and objectives were grouped under topic headings, which are displayed in bold. Each standard is followed by a performance example. In the excerpt below, 2.A is the topic; 2.A.01 is the first standard and 2.A.01.01 and 2.A.01.02 are the objectives under that standard.

### **2.A Automotive Technology Specific Safety Practices**

- 2.A.01 Identify and describe safety procedures when dealing with different types of automotive lifts according to current industry standards.
- 2.A.01.01 Demonstrate procedures for safe lift operations.
  - 2.A.01.02 Demonstrate safe use, placement and storage of floor jacks and jack stands.

2.A.01 Performance Example:

- Student will set up lift using manufacturer’s suggested lift points.

- 2.A.02 Demonstrate and describe safety procedures when dealing with high pressure systems including necessary ventilation according to current industry standards.
- 2.A.02.01 Describe and demonstrate the importance of safety procedures to be used when servicing high pressurized systems (fuel systems, brakes, air conditioning, suspension, hydraulic systems, etc.).
  - 2.A.02.02 Describe and demonstrate safe use of oxygen/acetylene torches and electric welding equipment.
  - 2.A.02.03 Demonstrate ventilation procedures to be followed when working in the lab/shop area.

2.A.02 Performance Example:

- Student will relieve fuel system pressure to perform necessary repairs.

- 2.A.03 Identify and describe safety procedures when dealing with electrical circuits according to current industry standards.
- 2.A.03.01 Describe safety procedures to be followed when servicing supplemental restraint systems.
  - 2.A.03.02 Demonstrate safety awareness of high voltage circuits of electric or hybrid electric vehicles and related safety precautions.

2.A.03 Performance Example:

- Safely disable Supplemental Restraint System (SRS) air bag for repair using manufacturer’s recommendations.

There are additional changes to some of the Frameworks Strand Two (Technical Knowledge and Skills). Specifically, Strand Two of the Frameworks for Animal Science, Environmental Science and Technology and Horticulture begin with core standards required for all participants in the programs, followed by a series of standards organized in concentrations. For example, Strand Two of the Horticulture Framework begins with the core standards required of all Horticulture students (Topics 2.A through 2.I). These standards are followed by the three concentrations: Arboriculture

(Topics 2.J through 2.L), Greenhouse Management and Floriculture (Topics 2.J. through 2.L) and Landscape and Turf Management (Topics 2.M through 2.Q).

### **Advanced / Supplemental Standards (Not Required)**

Another variation that is new to the revised Strand Two Frameworks is the addition of advanced or supplemental standards which are noted with the use of an asterisk (\*). *These standards are not required, but are provided as suggestions that districts may choose to use to increase the depth of a particular topic, or add additional topics, particularly for advanced students or for those seniors who do not participate in cooperative education.*

The following is an example from Automotive Technology, where entire topics were added:

#### ***Advanced Automotive Technology Technical Knowledge and Skills***

*Note: The following competencies are optional, supplementary competencies suitable for advanced students. These are not required.*

### **2.CC Demonstrate appropriate engine repair techniques.**

2.CC.01 Perform appropriate cylinder Head Repair.

2.CC.01.01\* Diagnose, remove and replace cylinder head(s).

2.CC.01.02\* Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition; determine necessary action.

The following is an example from the Strand Two Radio and Television Broadcasting Framework that shows the addition of an advanced objective, 2.B.04.08\*:

2.B.04 Explain concepts fundamental to shooting in cinema and video.

- 2.B.04.01 Compare and contrast a single-camera and a multiple-camera production.
- 2.B.04.02 Explain the importance of shooting for the edit (i.e., match on action, sequencing, coverage).
- 2.B.04.03 Explain the importance of continuity.
- 2.B.04.04 Explain the 180° Rule line, and its application in various cinema scenarios.
- 2.B.04.05 Identify and establish a specific point-of-view when shooting from a script.
- 2.B.04.06 Analyze the methods in which specific shots can evoke emotion from an audience.
- 2.B.04.07 Define drop frame and non-drop frame code shooting and explain how to account for both when preparing for an edit.
- 2.B.04.08\* Describe various cinematographic methods necessary when shooting scenes that incorporate post-production visual effect

2.B.04 Performance Examples:

- Students will list similarities and differences of single-camera and multiple-camera shoots.
- Students will describe multiple shooting considerations that are useful in streamlining the editing process.

# *Information Technology Services Occupational Cluster*

## *Information Support Services & Networking Framework (VISSN)*

### **Strand 1: Safety and Health Knowledge and Skills**

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#### **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.

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](http://www.doe.mass.edu/bullying)
- Centers for Disease Control and Prevention: [www.cdc.gov](http://www.cdc.gov)
- Environmental Protection Agency : [www.epa.gov](http://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](http://www.doe.mass.edu/cte)
- Massachusetts Department of Elementary and Secondary Education: [www.doe.mass.edu](http://www.doe.mass.edu)
- Massachusetts Emergency Management Agency: [www.mass.gov/eopss/agencies/mema](http://www.mass.gov/eopss/agencies/mema)
- Massachusetts General Law: [www.malegislature.gov](http://www.malegislature.gov)
- Massachusetts Health and Human Services: [www.mass.gov/dph](http://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](http://www.sdsonline.com)
- National Fire Protection Association: [www.nfpa.org](http://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](http://www.osha.gov)
- Readiness and Emergency Management for Schools: [www.rems.ed.gov](http://www.rems.ed.gov)
- Safe and Healthy Learning Environments: [www.doe.mass.edu/ssce/safety.html](http://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.03.03 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 model, 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.

2.1.02 Apply the OSI model.

- 2.1.02.01 Classify the differences between Layer 1, Layer 2 and Layer 3 applications, devices, and protocols as they relate to the OSI model layers.

2.1.02 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.

2.1.03 Explain the purpose and properties of IP Addressing.

- 2.1.03.01 Identify the Classes of addresses.
- 2.1.03.02 Describe Classless Inter-Domain Routing (CIDR).
- 2.1.03.03 Describe the differences between Internet Protocol version 4 (IPv4) vs. Internet Protocol version 6 (IPv6).
- 2.1.03.04 Distinguish differences between static and dynamic addressing.
- 2.1.03.05 Distinguish differences between public and private addressing.
- 2.1.03.06 Explain the components of the TCP/IP protocol including IP, subnet mask and default gateway.
- 2.1.03.07 Describe and prepare a subnet.
- 2.1.03.08 Differentiate among multicast, unicast and broadcast.
- 2.1.03.09 Detect Automatic Private IP Addressing (APIPA).

2.1.03 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.

2.1.04 Explain Dynamic Host Configuration Protocol (DHCP) concepts, describe its components and configure DHCP service.

- 2.1.04.01 Explain DHCP client and server side elements (reservations, scopes, leases).
- 2.1.04.02 Configure DHCP service.

2.1.04 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).

2.1.05 Explain Domain Name System (DNS) concepts, describe its components and install DNS servers.

- 2.1.05.01 Evaluate DNS servers, DNS records and Dynamic DNS.
- 2.1.05.02 Explain client side DNS.

2.1.05 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.Q.01 Performance Examples:
- Students will identify a popular web page editor and define the common parts of a web page and style sheets.
  - Students will create a webpage for a fictitious company, upload the webpage to an FTP server and administer changes to the webpage via an FTP client.

## **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.

## Strand 3: Embedded Academics

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Strand 3: Embedded Academics, a critical piece of a Vocational Technical Education Framework, are presented as Crosswalks between the Massachusetts Vocational Technical Education Frameworks and the Massachusetts Curriculum Frameworks. These Crosswalks are located in the Appendix of this Framework.

### **Academic Crosswalks**

[Appendix A:](#) [English Language Arts](#)

[Appendix B:](#) [Mathematics](#)

[Appendix C:](#) [Science and Technology/Engineering](#)

Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics)

Technology/Engineering

## Strand 4: Employability and Career Readiness

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### 4.A Career Exploration and Navigation

- 4.A.01 Develop a career plan and portfolio.
  - 4.A.01.01 Develop and revise career plan annually based on workplace awareness and skill attainment.
  - 4.A.01.02 Assess personal strengths and interest areas to determine potential careers, career pathways and career ladders.
  - 4.A.01.03 Examine potential career field(s)/discipline(s) and identify criteria to select, secure and keep employment in chosen field(s).
  - 4.A.01.04 Research and evaluate a variety of careers utilizing multiple sources of information and resources to determine potential career(s) and alternatives.
  - 4.A.01.05 Identify training and education requirements that lead to employment in chosen field(s) and demonstrate skills related to evaluating employment opportunities.
  - 4.A.01.06 Explore and evaluate postsecondary educational opportunities including degrees and certifications available, traditional and nontraditional postsecondary pathways, technical school and apprenticeships, cost of education, financing methods including scholarships and loans and the cost of loan repayment.
  - 4.A.01.07 Create a portfolio showcasing academic and career growth including a career plan, safety credential, resume and a competency profile demonstrating the acquisition of the knowledge and skills associated with at least two years of full-time study in the Chapter 74 program.
  
- 4.A.02 Demonstrate job search skills.
  - 4.A.02.01 Conduct a job search and complete written and electronic job applications, resumes, cover letters and related correspondence for a chosen career path.
  - 4.A.02.02 Explore and evaluate postsecondary job opportunities and career pathways specific to career technical areas.
  - 4.A.02.03 Identify role and use of social media and networking for staying current with career and employment trends as well as networking, job seeking and career development opportunities.
  - 4.A.02.04 Demonstrate ability to use social media and networking to develop useful occupational contacts, job seeking and career development opportunities.
  
- 4.A.03 Demonstrate all phases of the job interview process.
  - 4.A.03.01 Gather relevant information about potential employer(s) from multiple print and digital sources, assessing the credibility and accuracy of each source.
  - 4.A.03.02 Identify employment eligibility criteria, such as drug/alcohol free status, clean driving record, etc.

- 4.A.03.03 Practice effective interviewing skills: appearance, inquiry and dialogue with interviewer, positive attitude and evidence of work ethic and skills.
- 4.A.03.04 Explore and evaluate employment benefit packages including wages, vacation, health care, union dues, cafeteria plans, tuition reimbursement,

4. A Performance Examples:

- Conduct research to analyze and present on specific careers within a cluster.
- Conduct web-based job search using sites such as Monster.com, CareerBuilder.com, Indeed.com, Snagajob.com, Simplyhired.com and others.
- Create profile on social media/networking site such as LinkedIn and/or LinkedIn University for postsecondary research and employment opportunities.
- Complete online job application.
- Conduct and videotape practice interviews for instructor and student analysis.
- Provide students with sample employment and benefit packages for evaluation.

retirement and 401K.

**4.B Communication in the Workplace**

- 4.B.01 Demonstrate appropriate oral and written communication skills in the workplace.
  - 4.B.01.01 Communicate effectively using the language and vocabulary appropriate to a variety of audiences within the workplace including coworkers, supervisors and customers.
  - 4.B.01.02 Read technical and work-related documents and demonstrate understanding in oral discussion and written exercise.
  - 4.B.01.03 Demonstrate professional writing skills in work-related materials and communications (e.g., letters, memoranda, instructions and directions, reports, summaries, notes and/or outlines).
  - 4.B.01.04 Use a variety of writing/publishing/presentation applications to create and present information in the workplace.
  - 4.B.01.05 Identify, locate, evaluate and use print and electronic resources to resolve issues or problems in the workplace.
  - 4.B.01.06 Use a variety of financial and data analysis tools to analyze and interpret information in the workplace.
  - 4.B.01.07 Orally present technical and work-related information to a variety of audiences.
  - 4.B.01.08 Identify and demonstrate professional non-verbal communication.
- 4.B.02 Demonstrate active listening skills.
  - 4.B.02.01 Listen attentively and respectfully to others.
  - 4.B.02.02 Focus attentively, make eye contact or other affirming gestures, confirm understanding and follow directions.
  - 4.B.02.03 Show initiative in improving communication skills by asking follow-up questions of speaker in order to confirm understanding.

4. B Performance Examples:

- Read and analyze technical instructions to learn what makes them effective.
- Read and analyze technical instructions to follow directions and/or solve a problem.
- Examine a technical document and use it to write a set of instructions for another student to follow and evaluate.
- Analyze websites for effective technical writing and design.
- Create brochures and presentations using software and/or Web 2.0 tools to convey technical information.
- Conduct research using the Internet, print documents, observations and interviews to create a technical guide.

**4.C Work Ethic and Professionalism**

4.C.01 Demonstrate attendance and punctuality.

- 4.C.01.01 Identify and practice professional time-management and attendance behaviors including punctuality, reliability, planning and flexibility.

4.C.02 Demonstrate proper workplace appearance.

- 4.C.02.01 Identify and practice professional appearance specific to the workplace.
- 4.C.02.02 Identify and practice personal hygiene appropriate for duties specific to the workplace.
- 4.C.02.03 Identify and wear required safety gear specific to the workplace.

4.C.03 Accepts direction and constructive criticism.

- 4.C.03.01 Demonstrate ability (both verbally and non-verbally) to accept direction and constructive criticism and to implement solutions to change behaviors.
- 4.C.03.02 Ask appropriate questions to clarify understanding of feedback.
- 4.C.03.03 Analyze own learning style and seek instructions in a preferred format that works best for their understanding (such as oral, written or visual instruction).

4.C.04 Demonstrate motivation and initiative.

- 4.C.04.01 Evaluate assigned tasks for time to completion and prioritization.
- 4.C.04.02 Demonstrate motivation through enthusiasm, engagement, accurate completion of tasks and activities.
- 4.C.04.03 Demonstrate initiative by requesting new assignments and challenges.
- 4.C.04.04 Explain proposed solutions to challenges observed in the workplace.
- 4.C.04.05 Demonstrate the ability to evaluate multiple solutions to problems and challenges using critical reasoning and workplace/industry knowledge and select the best solution to the problem.
- 4.C.04.06 Implement solution(s) to challenges and/or problem(s) observed in the workplace.
- 4.C.04.07 See projects through completion and check work for quality and accuracy.

- 4.C.05 Demonstrate awareness of workplace culture and policy.
  - 4.C.05.01 Display ethical behavior in use of time, resources, computers and information.
  - 4.C.05.02 Identify the mission of the organization and/or department.
  - 4.C.05.03 Explain the benefits of a diverse workplace.
  - 4.C.05.04 Demonstrate a respect for diversity and its benefit to the workplace.
  
- 4.C.06 Interact appropriately with coworkers.
  - 4.C.06.01 Work productively with individuals and in teams.
  - 4.C.06.02 Develop positive mentoring and collaborative relationships within work environment.
  - 4.C.06.03 Show respect and collegiality, both formally and informally.
  - 4.C.06.04 Explain and follow workplace policy on the use of cell phones and other forms of social media.
  - 4.C.06.05 Maintain focus on tasks and avoid negative topics or excessive personal conversations in the workplace.
  - 4.C.06.06 Negotiate solutions to interpersonal and workplace conflicts.

4. C Performance Examples:

- Complete a learning style analysis tool.
- Develop a rubric to assess work ethic and professionalism as detailed in the standards above.

### Student Organizations

Business Professionals of America

[www.bpa.org](http://www.bpa.org)

### *Selected Websites*

- 5 Ways to Ace a Job Interview: [http://kidshealth.org/teen/school\\_jobs/jobs/tips\\_interview.html](http://kidshealth.org/teen/school_jobs/jobs/tips_interview.html)
- America's Career Resource Network: <http://acrn.ovae.org/teachers/careerexpclassrm.htm>
- Career Cruiser – Florida Department of Education:  
<http://www.fldoe.org/workforce/pdf/cruiser.pdf>
- Career Development Guide and Glossary: <http://www.doe.mass.edu/connect/cde.html>
- Career One Stop: <http://www.careeronestop.org/>
- Career Plan: <http://www.doe.mass.edu/cd/plan/intro.html>
- Career Plan Model: [http://www.doe.mass.edu/ccr/epp/samples/cpmodel\\_11x17.pdf](http://www.doe.mass.edu/ccr/epp/samples/cpmodel_11x17.pdf)
- Checklist: <http://www.doe.mass.edu/cd/plan/checklist.pdf>
- Career Tech: [http://www.okcareertech.org/cac/Pages/resources\\_products/ethics\\_web\\_sites.htm](http://www.okcareertech.org/cac/Pages/resources_products/ethics_web_sites.htm)
- Ethics Resource Center: <http://www.ethics.org/>
- Interaction in the Workplace: <http://hrweb.berkeley.edu/guides/managing-hr/interaction/communication>

- Individual Learning Plans: How-to Guide: “Promoting Quality Individualized Learning Plans: A How to Guide on the High School Years” <http://www.ncwd-youth.info/ilp/how-to-guide>
- ILP Fact Sheet: <http://www.ncwd-youth.info/fact-sheet/individualized-learning-plan>
- ILP Policy Brief: <http://www.ncwd-youth.info/ilp/produce-college-and-career-ready-high-school-graduates>
- ILP Resources Home Page: <http://www.ncwd-youth.info/ilp>
- Interview Skills Lesson Plans:  
<http://www.amphi.com/media/1220281/interview%20skills%20lesson%20plan.doc>
- Labor and Workforce Development: <http://www.mass.gov/lwd/employment-services/preparing-for-your-job-search/>
- Maine Community College System – Center for Career Development:  
[http://www.ccd.me.edu/careerprep/CareerPrepCurriculum\\_LP-6.pdf](http://www.ccd.me.edu/careerprep/CareerPrepCurriculum_LP-6.pdf)
- Massachusetts Work-Based Learning: <http://skillspages.com/masswbl>
- North Dakota Association of Agriculture Educators:  
[http://www.ndaae.org/attachments/File/Preparing\\_students\\_for\\_a\\_Job\\_Interview.pptx](http://www.ndaae.org/attachments/File/Preparing_students_for_a_Job_Interview.pptx)
- NY CTE Learning Standards—Career Development and Occupational Studies (CDOS) Resource Guide with Core Curriculum: <http://www.p12.nysed.gov/cte/cdlearn/cdosresourceguide.html>
- Occupational Outlook Handbook: <http://www.bls.gov/ooh/>
- Purdue OWL Job Search Resources (for writing resumes, applications, and letters):  
<https://owl.english.purdue.edu/engagement/34/>
- Soft Skills to Pay the Bills — Mastering Soft Skills for Workplace Success:  
<http://www.dol.gov/odep/topics/youth/softskills/>
- US Department of Labor: <http://www.dol.gov/dol/audience/aud-unemployed.htm>
- Workplace Communication:  
<http://www.regionalskillstraining.com/sites/default/files/content/WC%20Book%201.pdf>
- Your Plan For the Future: <http://www.yourplanforthefuture.org>

## Strand 5: Management and Entrepreneurship Knowledge and Skills

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### 5.A Starting a Business

- 5.A.01 Demonstrate an understanding of the practices required to start a business.
- 5.A.01.01 Define entrepreneurship and be able to recognize and describe the characteristics of an entrepreneur.
  - 5.A.01.02 Compare and contrast types of business ownership (i.e., sole proprietorships, franchises, partnerships, corporations).
  - 5.A.01.03 Identify and explain the purpose and contents of a business plan.
  - 5.A.01.04 Demonstrate an understanding of the principles and concepts of a business's supply chain (i.e., suppliers, producers and consumers).

5. A Performance Examples:

- Develop a presentation pertaining to an entrepreneur and their business.
- Communicate with a business owner and discuss the pros and cons of starting and owning a business. Summarize the main points of the discussion.
- Choose a product or service and describe the process leading to distribution.
- Write a business plan for a business in your community.

### 5.B Managing a Business

- 5.B.01 Demonstrate an understanding of managing a business.
- 5.B.01.01 Formulate short- and long-term business goals.
  - 5.B.01.02 Demonstrate effective verbal, written and visual communication skills.
  - 5.B.01.03 Utilize a decision-making process to make effective business decisions.
  - 5.B.01.04 Identify a business's chain of command and define its organizational structure.
  - 5.B.01.05 Identify and apply effective customer service skills and practices.
  - 5.B.01.06 Identify, interpret and develop written operating procedures and policies.
  - 5.B.01.07 Track inventory, productivity and labor cost.
  - 5.B.01.08 Demonstrate business meeting skills.
  - 5.B.01.09 Identify professional organizations and explore their benefits.

5. B Performance Examples:

- Working as a team, role-play situations that an entrepreneur might face in dealing with customers or employees.
- Contact a relevant professional organization and request information about its benefits, membership requirements and costs.
- Plan and conduct a business meeting.
- Identify companies that are known for customer service and list the practices that help differentiate themselves from all others in their industry.

### 5.C Marketing a Business

- 5.C.01 Demonstrate an understanding of marketing and promoting a business.
- 5.C.01.01 Explain the role of business in the economy.
  - 5.C.01.02 Describe the relationship between business and community.
  - 5.C.01.03 Describe methods of market research and identifying target markets.

- 5.C.01.04 Describe and apply the concepts of a marketing mix (the 4Ps of marketing: product, price, place and promotion).
- 5.C.01.05 Compare and contrast the promotional tools and techniques used to sell products, services, images and ideas.
- 5.C.01.06 Describe the impact of supply and demand on a product or business.
- 5.C.01.07 Identify direct and indirect competition on a business.
- 5.C.01.08 Identify and use sales techniques to meet client needs and wants.
- 5.C.01.09 Discuss strategies to acquire and retain a customer base.

5. C Performance Examples:
- Research reliable sources to identify marketing and industry data related to a business.
  - Conduct market research by developing a survey and presenting the results.
  - Create a promotional campaign using a variety of media.
  - Write a marketing plan for a product.

## 5.D Financial Concepts and Applications in Business

- 5.D.01 Demonstrate an understanding of financial concepts and applications.
  - 5.D.01.01 Identify essential financial reports and understand their purpose (i.e., budget, balance sheet and income statement).
  - 5.D.01.02 Describe payroll practices (i.e., deductions – federal, FICA and state taxes and insurances).
  - 5.D.01.03 Identify the importance of maintaining accurate records.
  - 5.D.01.04 Apply practices related to pricing, purchasing and billing.
  - 5.D.01.05 Maintain and reconcile a checking account.
  - 5.D.01.06 Identify the options for funding a business.

5. D Performance Examples:
- Given an employee time card and rate of pay, calculate gross pay, taxes, deductions and net pay.
  - Develop a budget for a simulated business or project.
  - Analyze and discuss financial documents from a company.
  - Research various methods of funding a business.

## 5.E Legal/Ethical/Social Responsibilities

- 5.E.01 Demonstrate an understanding of legal, ethical and social responsibility for businesses.
  - 5.E.01.01 Identify state and federal laws and regulations related to managing a business.
  - 5.E.01.02 Describe and identify ethical business practices.
  - 5.E.01.03 Demonstrate an understanding of business contracts.
  - 5.E.01.04 Explain the role of diversity in the workplace.
  - 5.E.01.05 Explain the role of labor organizations.
  - 5.E.01.06 Identify practices that support clean energy technologies and encourage environmental sustainability.
  - 5.E.01.07 Demonstrate an understanding of how technology advancements impact business practices.

5.E Performance Example:

- Read and interpret a contract.
- Complete an application for a license, permit or certificate.
- Research federal, state and local regulations and laws required for a business.
- Participate in and summarize a discussion with a member of a labor or civil rights organization.

### *Selected Websites*

- CVTE Strand 1, 4, and 5 Resources: <https://sites.google.com/a/mccanntech.org/cvte-strands-1-4-and-5-resources/>
- Entrepreneur: <http://www.entrepreneur.com>
- Inc. Magazine: <http://www.inc.com/>
- Junior Achievement “Be Entrepreneurial Program”: <https://www.juniorachievement.org/web/ja-usa/home>
- Kahn Academy Interviews with Entrepreneurs: <https://www.khanacademy.org/economics-finance-domain/entrepreneurship2/interviews-entrepreneurs>
- Kauffman Founders School: <http://www.entrepreneurship.org/en/founders-school.aspx>
- National Federation of Independent Business: [www.nfib.com](http://www.nfib.com)
- National Foundation for Teaching Entrepreneurship (NFTE): [www.nfte.com](http://www.nfte.com)
- SBA Loans: <http://www.sba.gov>
- SkillsUSA Professional Development Program Competency List: <http://www.skillsusa.org/downloads/PDF/lessons/professional/PDPPreview.pdf>
- Small Business Administration: [www.sba.gov](http://www.sba.gov)

### *Glossary*

<b>Term</b>	<b>Definition</b>
Balance sheet	A statement of the assets, liabilities and capital of a business at a particular point in time.
Budget	An estimate of income and expenditure for a set period of time.
Business Ownership	Types of business ownership refer to the legal structure of an organization. Legal structures include: Sole Proprietorship, Partnerships, Corporations and Limited Liability Companies.
Business Plan	A written document that describes in detail your business goals and how you are going to achieve them from a marketing, operational and financial point of view.

**Term**

Chain of Command and Organizational Structure

**Definition**

Refers to the management structure of an organization. It identifies lines of authority, lines of communication, and reporting relationships. Organizational structure determines how the roles, power and responsibilities are assigned and coordinated and how information flows between the different levels of management. (A visual representation of this structure is called an org chart).

FICA

Federal Insurance Contributions Act requires taxes deducted from pay for supporting Social Security.

Income Statement

A financial statement providing operating results for a specific time period showing a business's revenues, expenses and profit or loss.

Market Research

- Primary: Surveys, Focus Groups, Observation
- Secondary: Websites, Internet

Marketing Mix

A set of controlled variables that formulate the strategic position of a product or service in the marketplace. These variables are known as the 4 P's of marketing and include product, place, price and promotion.

Methods to Track Inventory, Productivity and Labor Cost

Refers to the processes a business uses to account for: 1) the inflows and outflows of inventory and materials related to inventory; 2) the efficiency of operations and 3) the cost of labor including salary and benefits.

Promotional Tools and Techniques

The six elements of a promotional mix are: advertising, visual merchandising, public relations, publicity, personal selling and sales promotion.

Supply Chain

The supply chain, or channel of distribution, describes how the product is handled and/or distributed from suppliers with materials, to the manufacturer, wholesaler or retailer and finally to the consumer.

Target Market

Those who are most likely to buy your product or service.

## Strand 6: Technology Literacy Knowledge and Skills

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### 6.A Technology Literacy Knowledge and Skills (Grades 9 through 12)

- 6.A.01 Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.
  - 6.A.01.01 Use online help and other support to learn about features of hardware and software, as well as to assess and resolve problems.
  - 6.A.01.02 Install and uninstall software; compress and expand files (if the district allows it).
  - 6.A.01.03 Explain effective backup and recovery strategies.
  - 6.A.01.04 Apply advanced formatting and page layout features when appropriate (e.g., columns, templates, and styles) to improve the appearance of documents and materials.
  - 6.A.01.05 Use editing features appropriately (e.g., track changes, insert comments).
  - 6.A.01.06 Identify the use of word processing and desktop publishing skills in various careers.
  - 6.A.01.07 Identify the use of database skills in various careers.
  - 6.A.01.08 Define and use functions of a spreadsheet application (e.g., sort, filter, find).
  - 6.A.01.09 Explain how various formatting options are used to convey information in charts or graphs.
  - 6.A.01.10 Identify the use of spreadsheet skills in various careers.
  - 6.A.01.11 Use search engines and online directories.
  - 6.A.01.12 Explain the differences among various search engines and how they rank results.
  - 6.A.01.13 Explain and demonstrate effective search strategies for locating and retrieving electronic information (e.g., using syntax and Boolean logic operators).
  - 6.A.01.14 Describe good practices for password protection and authentication.
- 6.A.02 Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.
  - 6.A.02.01 Demonstrate compliance with the school's Acceptable Use Policy.
  - 6.A.02.02 Explain issues related to the responsible use of technology (e.g., privacy, security).
  - 6.A.02.03 Explain laws restricting the use of copyrighted materials.
  - 6.A.02.04 Identify examples of plagiarism, and discuss the possible consequences of plagiarizing the work of others.
- 6.A.03 Design and implement a personal learning plan that includes the use of technology to support lifelong learning goals.
  - 6.A.03.01 Evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including Web sites.
  - 6.A.03.02 Analyze the values and points of view that are presented in media messages.
  - 6.A.03.03 Describe devices, applications, and operating system features that offer accessibility for people with disabilities.

- 6.A.03.04 Evaluate school and work environments in terms of ergonomic practices.
- 6.A.03.05 Describe and use safe and appropriate practices when participating in online communities (e.g., discussion groups, blogs, social networking sites).
- 6.A.03.06 Explain and use practices to protect one's personal safety online (e.g., not sharing personal information with strangers, being alert for online predators, reporting suspicious activities).
- 6.A.03.07 Explain ways individuals can protect their technology systems and information from unethical users.
- 6.A.04 Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.
  - 6.A.04.01 Devise and demonstrate strategies for efficiently collecting and organizing information from electronic sources.
  - 6.A.04.02 Compare, evaluate, and select appropriate electronic resources to locate specific information.
  - 6.A.04.03 Select the most appropriate search engines and directories for specific research tasks.
  - 6.A.04.04 Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, blogs), citing sources.
  - 6.A.04.05 Demonstrate how the use of various techniques and effects (e.g., editing, music, color, rhetorical devices) can be used to convey meaning in media.
  - 6.A.04.06 Use online communication tools to collaborate with peers, community members, and field experts as appropriate (e.g., bulletin boards, discussion forums, listservs, web conferencing).
  - 6.A.04.07 Plan and implement a collaborative project with students in other classrooms and schools using telecommunications tools (e.g., e-mail, discussion forums, groupware, interactive Web sites, video conferencing).

## Appendices

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The framework teams created an “Appendix” listing potential industry recognized credentials attainable by secondary students; lists of professional, student, and relevant government organizations; and useful resources and websites. ***\* It is important to note that although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted.***

***Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education.***

## Embedded Academic Crosswalks

### Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
2.A.04 2.F.06.01 2.F.01.02 2.G.04 2.G.09.02	SL Grades 9-10 1.a-d	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>• Throughout the course and the presentation of material, students will engage in active discussion and presentation of ideas.</li> <li>• Students will question concepts to expand knowledge-base.</li> <li>• Students will use prior knowledge to question and discuss new ideas.</li> </ul>		
2.B.01 2.B.05 2.F.01.03	WHST Grades 9-10 2a,b,d  WHST Grades 9-10 4  WHST Grades 9-10 6  WHST Grades 9-10 8  WHST Grades 9-10 9  RST Grades 9-10 1  RST Grades 9-10	<p>Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.</p> <p>Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p> <p>Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.</p> <p>Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>• Create an electronic presentation that shows the evaluation of the technology advancements in the IT field and how it has impacted society today.</li> <li>• Create a tri-fold presentation of industry-related certification and highlight 3 different career paths in the IT field.</li> <li>• Create an electronic mapping of upgrade paths for various operating systems.</li> </ul>		
2.B.02 2.B.04 2.B.04.03 2.C.05.01 2.C.09.01 2.E.01.02	WHST Grades 9-10 2.a,b,c  WHST Grades 9-10 4	<p>Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

2.F.02.01 2.F.05.04 2.G.06.01	WST Grades 9-10 9	Draw evidence from informational texts to support analysis, reflection, and research.
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>• Using background research, describe and explain in various forms of written summaries: <ul style="list-style-type: none"> <li>a. Certifications available to IT professionals.</li> <li>b. The use of technology in the workplace and in society.</li> <li>c. Devices and procedures to protect against environmental factors</li> <li>d. The differences in RAM types.</li> <li>e. The differences in display devices and the required cabling.</li> <li>f. The imaging process of various printers.</li> <li>g. The various methods of booting up a system.</li> <li>h. The purpose and use of system files and folders</li> <li>i. The various methods of network access security.</li> </ul> </li> </ul>		
2.B.03 2.A.01.01 2.A.01.02 2.C.05.04 2.C.09.02 2.C.09.03 2.F.05.05 2.G.06.02 2.G.07 2.G.08 2.G.09.03 2.G.10.01	RST Grades 9-10 1  RST Grades 9-10 4  WHST Grades 9-10 2.a, b, c  WHST Grades 9-10 4  WHST Grades 9-10 7  WHST Grades 9-10 8  WHST Grades 9-10 9  WHST Grades 9-10 10	<p>Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.</p> <p>Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.</p> <p>Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p> <p>Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>• Students read text and write about their findings, citing information from research. <ul style="list-style-type: none"> <li>a. Using background research and references describe and draw conclusions about the impact of technology on society.</li> <li>b. Students use research to write about the dangers of ESD and describe the tools to protect against ESD.</li> <li>c. Students will use research to describe the various types of RAID devices</li> <li>d. Students will explain the technical terms related to display devices.</li> <li>e. Students will describe the process of how a user is authenticated.</li> <li>f. Students will describe the various methods of network access.</li> <li>g. Students will describe and define tools used as part of setting up a firewall and other network security devices and configuration.</li> </ul> </li> </ul>		

2.A.01.01 2.A.01.02 2.C.05.04 2.C.06.01 2.C.09.02 2.C.09.03 2.F.05.05 2.G.07 2.G.08 2.G.10.01	SL Grades 9-10 4  SL Grades 9-10 6	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.  Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 on page 67 for specific expectations.)
Performance Example: <ul style="list-style-type: none"> <li>• Students read text and present their findings, citing information from research. <ol style="list-style-type: none"> <li>a. Describe the tools to protect against ESD</li> <li>b. Describe the various RAID device types</li> <li>c. Describe the features of CPU types and the proper cooling techniques per type.</li> <li>d. Describe the terms associated with display devices.</li> <li>e. Describe the process of how users are authenticated.</li> <li>f. Explain the functions of network security appliances.</li> </ol> </li> </ul>		
2.A.01.03 2.A.04.02 2.C.05.03 2.F.03.01	RST Grades 9-10 3  SL Grades 9-10 4	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
Performance Example: <ul style="list-style-type: none"> <li>• Students will read and follow instructions to perform a specific activity in a presentation to the class. <ol style="list-style-type: none"> <li>a. Demonstrate use of ESD safety tools.</li> <li>b. Demonstrate how to monitor environmental factors.</li> <li>c. Demonstrate the various uses of media types.</li> <li>d. Demonstrate the various tools and features of an operating system.</li> </ol> </li> </ul>		
2.A.01.04 2.A.03 2.A.04.04 2.C.01 2.C.04.02 2.C.05.02 2.C.06.02 2.C.06.03 2.C.07 2.C.10 2.D.01.02 2.E.01.03 2.E.01.04 2.F.02.03 2.F.02.04 2.F.02.06 2.F.03.02 2.F.03.03 2.F.03.04 2.F.04 2.F.05.01	RST Grades 9-10 3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

2.G.03 2.G.05		
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>• Students will read and follow a set of guidelines or instructions. <ul style="list-style-type: none"> <li>a. Implement OSHA guidelines</li> <li>b. Use documentation to implement rules and policies for dealing with restricted content.</li> <li>c. Implement protection from environmental factors</li> <li>d. Configure a computer with appropriate hardware and software settings, including security requirements, software and settings.</li> <li>e. Configure various forms of external devices.</li> <li>f. Perform printer maintenance on various types of printers.</li> </ul> </li> <li>• Students will execute various activities on various forms of IT components including <ul style="list-style-type: none"> <li>a. Peripherals</li> <li>b. Printers</li> </ul> </li> <li>• Students will use documentation to explore and use various tools and utilities as assigned.</li> <li>• Students will use documentation to modify parameters of various drivers, operating systems and tools and determine effect on performance and user.</li> </ul>		
2.A.03.01	SL Grades 9-10 6  L Grades 9-10 6	<p>Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 on page 67 for specific expectations.)</p> <p>Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>• Students will use proper English to convey ideas and avoid technical jargon in appropriate settings.</li> <li>• Students will use jargon and acronyms in appropriate context when speaking or writing.</li> </ul>		
2.A.02.02 2.A.02.03	SL Grades 9-10 1.a, c, d  SL Grades 9-10 4  SL Grades 9-10 6  SL Grades 9-10 1.a, c, d	<p>Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.</p> <p>Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 on page 67 for specific expectations.)</p> <p>Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>• Students will engage in an activity to meet with customers of various technical levels to discuss requirements for an IT project.</li> <li>• Students will engage in an activity to meet with customers presenting challenges of attitude, knowledge, readiness, cultural differences and other hurdles to overcome in dealing with the public and customers.</li> </ul>		

2.C.02.01 2.C.02.02 2.C.03.02 2.C.04.01 2.D.01.01 2.F.02.02 2.G.09.01	RST Grades 9-10 1  RST Grades 9-10 3  RST Grades 9-10 4  RST Grades 9-10 10	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.  Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.  By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently
Performance Example: <ul style="list-style-type: none"> <li>Students will read and research differences between computer components and then use this information to find and download applicable technology as part of an IT project.</li> </ul>		
2.C.08.01 2.F.02.05 2.F.06.02	RST Grades 9-10 1  RST Grades 9-10 4  RST Grades 9-10 5  RST Grades 9-10 7  RST Grades 9-10 10	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.  Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).  Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.  By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently
Performance Example: <ul style="list-style-type: none"> <li>Students will view various forms of requirements documents to determine what components are needed to satisfy those requirements.</li> </ul>		
2.D.01.03 2.D.02 2.E.01.01 2.F.01.01 2.F.05 2.F.05.02 2.G.01.01 2.G.02 2.G.04.01 2.G.09.04	RST Grades 9-10 1  RST Grades 9-10 2  RST Grades 9-10 4  RST Grades 9-10 5  RST Grades 9-10 6	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.  Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.  Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).  Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.  Compare and contrast findings presented in a text to those from

	<p>RST Grades 9-10 9</p> <p>RST Grades 9-10 10</p> <p>WHST Grades 9-10 2.a-f</p> <p>WHST Grades 9-10 4</p> <p>WHST Grades 9-10 5</p> <p>WHST Grades 9-10 7</p> <p>WHST Grades 9-10 8</p> <p>WHST Grades 9-10 9</p> <p>WHST Grades 9-10 10</p>	<p>other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.</p> <p>By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.</p> <p>Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.</p> <p>Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p> <p>Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.</p> <p>Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>• Students will read and research evidence to compare and contrast features and elements of an IT project. Output can be in various forms of writing – either a bullet-list selection of comparison to a more detailed writing and documentation of why one would select one component over the other based on requirements. <ul style="list-style-type: none"> <li>a. Discuss and document laptop display features and the selection criteria.</li> <li>b. Document the differences between printer types and what one you would select for various job types.</li> <li>c. Document the differences in operating systems and create a decision matrix that would describe the process for selecting the correct system for particular requirements.</li> <li>d. Explain the differences and the interaction between operating system security settings.</li> <li>e. Explain and document physical and digital security techniques – how they work together and how they work stand-alone.</li> <li>f. Compare, contrast and explain common security threats and how one would protect against each type of threat.</li> <li>g. Explain data destruction techniques and the level of security affects between the various types.</li> <li>h. Document the differences between inspection techniques related to firewall configuration.</li> </ul> </li> </ul>		

## Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.A.01.01	9-12.A.CED.4  9-12.N-Q.3a	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance $R$ . Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. Identify significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure.*
Performance Example: <ul style="list-style-type: none"> <li>Students will be able to calculate and analyze results of electrical static discharge *</li> </ul>		
2.C.02 2.C.03.02 2.C.04 2.C.05 2.C.07 2.C.08.02 2.C09.02 2.D.01 2.E.01 2.F.01.02 2.H.04 2.I.09.01	9-12.N-Q.1  7.EE.3  7.RP.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.* Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations as strategies to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. Analyze proportional relationships and use them to solve real-world and mathematical problems. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $(\frac{1}{2})/(\frac{1}{4})$ miles per hour, equivalently 2 miles per hour
Performance Examples: <ul style="list-style-type: none"> <li>Student will be able to apply correct unit conversions to calculate bus speeds, storage and memory capacity for Motherboard components and hardware devices.</li> <li>Student will be able to correctly configure replacement hardware devices and components.</li> <li>Student will be able to analyze total cost of ownership for a given printer and usage rates.</li> </ul>		
2.C.02.02 2.I.10	9-12.G.CO.1  7.G.2	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
Performance Example: <ul style="list-style-type: none"> <li>Student will be able to analyze size and shape of form factors of components to properly select and install motherboard and power supplies within a computer chassis.</li> </ul>		
2.C.06.02	9-12.F.LE.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*
Performance Example:		

<ul style="list-style-type: none"> <li>Students will be able to apply Moore's Law as it applies to CPU speeds to create a data table of different CPU types.</li> </ul>		
2.G.09.03 2.I.03 2.I.04 2.I.10.02	CVTE  5.NBT.2	Apply Boolean Algebra concepts to design logical operations and Number theory of Binary, Octal, and Hexadecimal number systems  Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole number exponents to denote powers of 10.(NOTE: Perhaps the foundation needed to expand into base 2, base 8, and base 16.)
<p>Performance Examples:</p> <ul style="list-style-type: none"> <li>Student will be able to convert units between decimal, binary, and hexadecimal as needed within subnetting scenarios.</li> <li>Student will apply relational operators (equal, not equal, greater than, or less than) and logical operators (and, or not) in an expression to develop a project flow chart.</li> </ul>		
2.J.01 2.J.02 2.J.03	7.RP.1  9-12.S.IC.6  7.G.2	Analyze proportional relationships and use them to solve real-world and mathematical problems. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction (1/2)/(1/4) miles per hour, equivalently 2 miles per hour  Evaluate reports based on data.*  Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>Student will be able design an appropriate network and cabling scheme and calculate costs associated with implementing the network.</li> </ul>		

## Embedded Science and Technology/Engineering

### *Earth and Space Science*

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Earth and Space Science Learning Standard
2.F.02.05	Grades 3-5 # 14	Recognize that the earth revolves around (orbits) the sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>Select suitable setting for operating system customization.</li> </ul>		
2.F.02.05	1. Matter and Energy in the Earth System 1.5	Explain how the revolution of Earth around the Sun and the inclination of Earth on its axis cause Earth's seasonal variations (equinoxes and solstices).
<p>Performance Example:</p>		

- Select suitable setting for operating system (selecting time zone explaining the sun, earth-moon system as well as leap years, centuries and seconds).

### *Life Science (Biology)*

<b>CVTE Learning Standard Number</b>	<b>Subject Area, Topic Heading and Learning Standard Number</b>	<b>Text of Biology Learning Standard</b>
2.B.04.01 2.E.01.04 2.G.04.02	6. Ecology 6.2	Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.
Performance Examples: <ul style="list-style-type: none"> <li>• Reference SDS (Material Safety Data Sheets) and manufacturer's recommendations for handling, protection and disposal of components and materials.</li> <li>• Distribute the contents of chemical storage cabinet one per student and have them find the SDS on-line Update the OSHA required log book.</li> </ul>		

### *Physical Science (Physics)*

<b>CVTE Learning Standard Number</b>	<b>Subject Area, Topic Heading and Learning Standard Number</b>	<b>Text of Physics Learning Standard</b>
2.C.06.03	3. Heat Transfer 3.1	Explain how heat energy is transferred by convection, conduction and radiation
Performance Example: <ul style="list-style-type: none"> <li>• Explain why dust clogging the intake screen will defeat the cooling properties of the fan and remedy the situation</li> </ul>		
2.C.06.03	3. Heat Transfer 3.2	Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.
Performance Example: <ul style="list-style-type: none"> <li>• Demonstrate the correct application of thermal compound and explain why too little could be disastrous to the life of the system.</li> </ul>		
2.C.06.03	3. Heat Transfer 3.4	Explain the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.
Performance Example: <ul style="list-style-type: none"> <li>• Describe how a Heat-sink works and then properly install it.</li> </ul>		
2.B.01.01	5. Electromagnetism 5.1	Recognize that an electrical charge tends to be static on insulators and can move on and in conductors, Explain that energy can produce a separation of charges
Performance Example: <ul style="list-style-type: none"> <li>• Explain why power supplies are firmly attached to the chassis providing adequate grounding and ensure your installation complies.</li> </ul>		
2.B.01.01 2.C.07.01 2.I.01 2.I.02 2.L.10	5. Electromagnetism 5.2	Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		

<ul style="list-style-type: none"> <li>Calculate the voltage required for a particular configuration of computer hardware and determine the proper power supply output needed.</li> </ul>		
2.C.05.01 2.G.04.01 2.E	5. Electromagnetism 5.6	Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.
2.I.02 2.I.09.01 2.L.11	6. Electromagnetic Radiation. 6.2	Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green, blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the spectrum.
Performance Example: <ul style="list-style-type: none"> <li>Explain why infrared only works in line of sight situations using only a graph of the electromagnetic spectrum as evidence.</li> </ul>		
2.A.01.01	5. Electromagnetism 5.5	Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage
Performance Example: <ul style="list-style-type: none"> <li>Explain the dangers of ESD (electro static discharge)</li> </ul>		

### *Technology/Engineering*

<b>CVTE Learning Standard Number</b>	<b>Subject Area, Topic Heading and Learning Standard Number</b>	<b>Text of Technology/Engineering Learning Standard</b>
2.C.07.01	5. Energy and Power Technologies—Electrical Systems 5.5	Compare and contrast alternating current (AC) and direct current (DC), and give examples of each
Performance Example: <ul style="list-style-type: none"> <li>Illustrate the main function of a computer power supply before installing it (converts AC to DC)</li> </ul>		

## DESE Statewide Articulation Agreements

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### **ARTICULATION AGREEMENT**

*Between*

Massachusetts Community Colleges

*And*

Massachusetts Chapter 74-Approved Secondary  
Career/Vocational Technical Information Support Services and Networking Programs

Effective Date: December 5, 2012

*for more information, click*

<http://www.masscc.org/partnerships-initiatives/voc-schools-articulation-agreements>

## Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

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- Comp TIA A+
- Comp TIA Net+
- Comp TIA Strata
- OSHA 10 Hour
- Skills Connect
  - Computer Maintenance Technology
  - Internetworking
  - Employability
- NOCTI
  - Computer Networking Fundamentals
  - Computer Repair Technology
  - Computer Technology
- Cisco
  - Networking Academy Certificates of Course Completion (ie: IT Essentials, Discovery I & II)
  - CCENT (Cisco Certified Entry Networking Technician)
  - CCNA (Cisco Certified Network Associate)
  -
- Microsoft
  - MTA (Microsoft Technology Associate)
  - Microsoft MCTS (Microsoft Certified Technical Specialist)
  - Microsoft MOS (Microsoft Office Specialist)
  - Digital Literacy
- IC3 -Internet and Computing Core Certification
- TestOut
  - PC Pro Certification
  - Network Pro Certification
  - Security Pro Certification
- Heath Kit PC Fundamentals
- Adobe
  - ACE (Adobe Certified Expert)

## Other

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### Reference Materials

- CompTIA A+ Essentials Lesson Plan, 2009, Testout Corporation, Pleasant Grove, Utah
- CompTIA A+ Practical Applications Lesson Plans, 2009, Testout Corporation, Pleasant Grove, Utah
- CompTIA Network + Lesson Plans, 2009, Testout Corporation, Pleasant Grove, Utah
- CompTIA A+ 220-701 Lesson Plans, 2009, CompTIA Corporation, Downers Grove, Illinois
- CompTIA A+ 220-702 Lesson Plans, 2009, CompTIA Corporation, Downers Grove, Illinois
- CompTIA A+ 220-801 Objectives, CompTIA Corporation, Downers Grove, Illinois
- CompTIA A+ 220-802 Objectives, CompTIA Corporation, Downers Grove, Illinois
- CompTIA Network + N10-004 Objectives, CompTIA Corporation, Downers Grove, Illinois
- CompTIA Network + N10-005 Objectives, CompTIA Corporation, Downers Grove, Illinois
- IC3 Certification Objectives, Certiport, Inc., American Fork, Utah
- Information Support, Services, and Networking Frameworks, 2007, Department of Elementary and Secondary Education, Malden, Massachusetts
- Massachusetts Technology Literacy Standards and Expectations, 2008, Department of Elementary and Secondary Education, Malden, Massachusetts
- Microsoft Certification Objectives, Microsoft Corporation, Redmond, Washington
- Network Pro Lesson Plans, Testout Corporation, Pleasant Grove, Utah
- PC Pro Lesson Plans, Testout Corporation, Pleasant Grove, Utah

### Professional Organizations

#### **Association for Educational Communications and Technology (AECT)**

<http://www.aect.org/>

The mission of the Association for Educational Communications and Technology is to provide leadership in educational communications and technology by linking professionals holding a common interest in the use of educational technology and its application to the learning process.

#### **Association for the Advancement of Computing in Education (AACE)**

<http://www.aace.org/>

The Association for the Advancement of Computing in Education (AACE), founded in 1981, is an international, not-for-profit, educational organization with the mission of advancing Information Technology in Education and E-Learning research, development, learning, and its practical application.

#### **Broadening Advanced Technological Education Connections (BATEC)**

<http://www.batec.org/>

Broadening Advanced Technological Education Connections (BATEC) provides multiple opportunities for partnering with us throughout Massachusetts. Whether you are an educator working on curriculum or professional development, or a current or future student pursuing education and/or a career in IT, or a business wanting a qualified technical workforce, BATEC welcomes you to get involved.

#### **The eLearning Guild**

<http://www.elearningguild.com/>

The eLearning Guild is a source of information, networking, and community for e-learning professionals. As a member-driven organization, the Guild produces conferences, online events, e-books, research reports, and Learning Solutions Magazine, all of which are devoted to the idea that the people who know the most about making e-Learning successful are the people who produce e-learning every day in corporate, government, and academic settings. The organization's goal is to create a place where e-learning professionals can share their knowledge, expertise, and ideas to build a better industry and better learning experiences for everyone.

### **IEEE Technical Committee on Learning Technology (IEEE TCLT)**

<http://lttf.ieee.org/>

The IEEE Technical Committee on Learning Technology (TCLT) was founded on the premise that emerging technology has the potential to dramatically improve learning. The purpose of this technical committee is to contribute to the field of Learning Technology and to serve the needs of professionals working in this field. TCLT has initiated a number of activities to promote research and development of Advanced Learning Technologies. These activities foster collaboration among academic and professional communities

### **International Society for Technology in Education (ISTE)**

<http://www.iste.org/>

ISTE is the largest teacher-based, nonprofit organization in the field of educational technology. Its mission is to help K-12 classroom teachers and administrators share effective methods for enhancing student learning through the use of new classroom technologies.

### **International Technology and Engineering Education Association (ITEEA)**

<http://www.iteaconnect.org/>

The International Technology and Engineering Education Association (ITEEA) is the professional organization of technology and engineering teachers. Their mission is to promote technological literacy for all by supporting the teaching of technology and promoting the professionalism of those engaged in this pursuit. ITEEA strengthens the profession through leadership, professional development, membership services, publications, and classroom activities.

### **Massachusetts Technology Education Engineering Collaborative**

<http://www.masstec.org/>

This organization is an affiliate of the International Technology Education and Engineering Educators Association. We support the national learning standards in the Standards for Technological Literacy, and in the Massachusetts Science and Technology/Engineering Curriculum Framework.

### **Society for Applied Learning Technology (SALT)**

<http://www.salt.org/>

Founded in 1972, membership in the Society for Applied Learning Technology (SALT) is oriented to professionals whose work requires knowledge and communication in the field of instructional technology. It is a professional society, designed for individual membership participation with classes of membership keyed to the interest and experience of the individual. SALT also sponsors two major conferences per year, one in Orlando, and one in Northern Virginia.

## Student Organizations

### **Technology Student Association**

<http://www.tsaweb.org/>

The Technology Student Association (TSA) is a national, non-profit organization for middle and high school students with a strong interest in technology. Since TSA was chartered in 1978 over 2,000,000 students have participated. The Technology Student Association fosters personal growth, leadership, and opportunities in technology, innovation, design, and engineering. Members apply and integrate science, technology, engineering and mathematics (STEM) concepts through co-curricular activities, competitive events and related programs.

**Skills USA**

<http://www.skillsusa.org/>

SkillsUSA is a partnership of students, teachers and industry working together to ensure America has a skilled workforce. SkillsUSA helps each student excel. SkillsUSA is a national nonprofit organization serving teachers and high school and college students who are preparing for careers in trade, technical and skilled service occupations, including health occupations. It was formerly known as VICA (Vocational Industrial Clubs of America).