

Massachusetts Department of Elementary & Secondary Education

Office for Career/Vocational Technical Education



Vocational Technical Education Framework



Information Technology Services Occupational Cluster

Programming & Web Development (VPROG)

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Massachusetts Department of Elementary and Secondary Education

Office for Career/Vocational Technical Education

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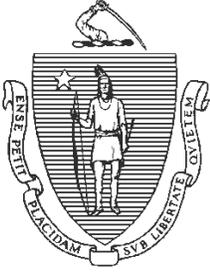
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Commissioner's Letter



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Mitchell D. Chester, Ed.D.
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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

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.

Appendix¹

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 Appendix² 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.

¹ *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

Programming and Web Development Framework (VPROG)

Strand 1: Safety and Health Knowledge and Skills

1.A Fundamentals of Health and Safety

- 1.A.01 Describe and apply health and safety regulations.
- 1.A.01.01 Identify, describe and apply health and safety regulations that apply to specific tasks and jobs. Students must complete a safety credential program, e.g., Occupational Safety and Health Administration 10, CareerSafe and ServSafe.
 - 1.A.01.02 Identify, describe and apply Environmental Protection Agency (EPA) and other environmental protection regulations that apply to specific tasks and jobs in the specific occupational area.
 - 1.A.01.03 Identify, describe and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the specific occupational area.
 - 1.A.01.04 Explain procedures for documenting and reporting hazards to appropriate authorities.
 - 1.A.01.05 Identify and describe potential consequences for non-compliance with appropriate health and safety regulations.
 - 1.A.01.06 Identify and list contact information for appropriate health and safety agencies and resources.

1. A.01 Performance Examples:

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

- 1.A.02 Demonstrate appropriate health and safety practices based on the specific occupational area.
- 1.A.02.01 Identify, describe and demonstrate the effective use of Safety Data Sheets (SDS).
 - 1.A.02.02 Read and interpret chemical, product and equipment labels to determine appropriate health and safety considerations.
 - 1.A.02.03 Identify, describe and demonstrate personal, shop and job site safety practices and procedures.
 - 1.A.02.04 Demonstrate safe dress and use of relevant safety gear, personal protective equipment (PPE) and ergonomics, e.g., wrist rests, adjustable workspaces, equipment, gloves, proper footwear, earplugs, eye protection and breathing apparatus.
 - 1.A.02.05 Demonstrate appropriate safe body mechanics, including appropriate lifting techniques and ergonomics.
 - 1.A.02.06 Locate emergency equipment, first aid kit, SDS information directories and emergency action/response plan/escape routes in your lab, shop and

classroom, including labels and signage that follow OSHA Hazard Communication Program (HAZCOM), eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches and emergency exits.

1.A.02.07 Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop and classroom, e.g., the OSHA Lockout/Tagout Program (LOTO).

1.A.02.08 Describe safety practices and procedures to be followed when working with and around electricity, e.g., ground fault circuit interrupter (GFCI) and frayed wiring.

1.A.02.09 Handle, store, dispose of and recycle hazardous, flammable and combustible materials, according to EPA, OSHA and product specifications.

1.A.02.10 Demonstrate appropriate workspace cleaning, sanitation, disinfection and sterilization procedures required in specific occupational areas, e.g., Workplace Housekeeping OSHA Regulations.

1. A.02 Performance Examples:

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

1.A.03 Demonstrate appropriate responses to situations that may threaten health and safety.

1.A.03.01 Describe First Aid procedures for potential injuries and other health concerns in the specific occupational area.

1.A.03.02 Describe the importance of emergency preparedness and an emergency action/response plan.

1.A.03.03 Describe procedures used to handle emergency situations, defensive measures and accidents, including identification, reporting, response, evacuation plans and follow-up procedures.

1.A.03.04 Identify, describe and demonstrate safety practices in specific occupational areas used to avoid accidents.

1.A.03.05 Identify and describe fire protection, protection, precautions and response procedures.

1.A.03.06 Discuss the role of the individual and the company/organization in ensuring workplace safety including transportation to and from school, school activities and the workplace.

1.A.03.07 Discuss ways to identify, prevent and report school and workplace violence, discrimination, harassment and bullying.

1.A.03.08 Demonstrate positive and appropriate behavior that contributes to a safe and healthy environment in school and the workplace.

1. A.03 Performance Example:

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

Selected Websites

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

Strand 2: Technical Knowledge and Skills

2.A Fundamentals of Computer Information Technology

- 2.A.01 Demonstrate safety and health in a computer environment.
- 2.A.01.01 Demonstrate safe body mechanics with regard to computer workstation ergonomics.
 - 2.A.01.02 Identify and apply electrical safety practices with regard to computers.
 - 2.A.01.03 Explain the impact of electrostatic discharge with regard to computers.

2.A.01 Performance Example:

- Students will create a presentation on an aspect of computer environment safety.

- 2.A.02 Explain the role of information technology in the workplace and community.
- 2.A.02.01 Describe the evolution of information technology.
 - 2.A.02.02 Describe and classify professional certifications.
 - 2.A.02.03 Explain the impact of technologies on society.
 - 2.A.02.04 List types of technologies and describe their uses in the workplace and society.
 - 2.A.02.05 List and describe uses of social media in workplace/community.

2.A.02 Performance Example:

- Students will create a presentation on an aspect of social media and its effect in the workplace and community.

- 2.A.03 Explain concepts fundamental to security.
- 2.A.03.01 Identify security principles, vulnerability and threats in software.
 - 2.A.03.02 Assess principles of secure passwording strategies.
 - 2.A.03.03 Define fundamental legal issues involved with security management.

2.A.03 Performance Example:

- Students will identify web site security issues, protection of hardware, and anti-virus software protection.

- 2.A.04 Demonstrate concepts fundamental to graphic tools.
- 2.A.04.01 Create and manipulate illustrations using a graphic tool.
 - 2.A.04.02 Demonstrate the use of digital cameras.
 - 2.A.04.03 Transfer files from a digital camera.
 - 2.A.04.04 Create and manipulate digital image using a graphic tool.
 - 2.A.04.05 Create and differentiate between digital image file formats.
 - 2.A.04.06 Differentiate between digital video file formats.
 - 2.A.04.07 Differentiate between digital audio file formats.

2.A.04 Performance Example:

- Students will design and publish a web page incorporating multimedia and graphic components.

- 2.A.05 Explain concepts fundamental to networking.
- 2.A.05.01 Describe the purposes of a network.
 - 2.A.05.02 Differentiate between internet and intranets.
 - 2.A.05.03 Differentiate between network types such as local area networks (LANs), metro area networks (MANs), and wide area networks (WANs).

- 2.A.05 Performance Examples:
- Students will explain the different network classifications and terms such as LANs, MANs and WANs.
 - Students will write three questions in which the answer is either LAN, MAN, or WAN.

- 2.A.06 Explain concepts fundamental to operating systems.
- 2.A.06.01 Describe the purpose of an operating system.
- 2.A.06.02 Differentiate between operating system (OS) platforms such as Macintosh (MAC), personal computer (PC), server, and mobile devices.

- 2.A.06 Performance Example:
- Students will use the Internet to research and report on multiple operating systems.

- 2.A.07 Explain concepts fundamental to databases.
- 2.A.07.01 Explain database concepts.
- 2.A.07.02 Explain the purpose of a relational database.
- 2.A.07.03 Demonstrate the planning and designing of a relational database.
- 2.A.07.04 Classify the relationship between tables such as one-to-one and one-to-many.
- 2.A.07.05 Give examples of database queries and data reports.

- 2.A.07 Performance Examples:
- Students will create a customer data base with two tables (customer info and customer sales), and link tables with one-to-many relationship.
 - Students will create a standard query giving total counts from one field.

- 2.A.08 Describe and classify computer hardware.
- 2.A.08.01 Differentiate between computer types such as desktops, laptops, tablets, and handhelds.
- 2.A.08.02 Classify hardware components, their functions and relationships.

- 2.A.08 Performance Example:
- Given a set of hardware components, students will identify their location in a system.

- 2.A.09 Explain concepts fundamental to server-side technologies.
- 2.A.09.01 Differentiate between client-server and stand-alone applications.
- 2.A.09.02 Explain the concepts of client-server technology.
- 2.A.09.03 Compare various server-side technologies such as their strengths and weaknesses.

- 2.A.09 Performance Examples:
- Students will define server-side technologies.
 - Students will distinguish among CGI/Perl, Hypertext Preprocessor (PHP), and Active Server Pages (ASP) technologies.

2.B Elements of Software Development

- 2.B.01 Demonstrate problem solving and troubleshooting techniques.
- 2.B.01.01 Discover and document a problem.
- 2.B.01.02 Determine a problem's possible causes.
- 2.B.01.03 Use known information for problem solving.
- 2.B.01.04 Use reference materials for problem solving.
- 2.B.01.05 Apply gathered information to the problem.

2.B.01.06 Formulate possible solutions to the problem.

2.B.01 Performance Examples:

- Students will interview a customer with a computer problem, document and research issue, and propose solution or direct them to appropriate resources.
- Students will develop a problem statement.

2.B.02 Determine software requirements.

2.B.02.01 Collaborate with client to determine needs and wants.

2.B.02.02 Determine the technical requirements describing what a system solution from 2.B.01 is to do.

2.B.02 Performance Examples:

- Students will prepare a technical requirements document describing what a system solution from 2.B.01 is to do.
- Students will gather the known information and present the expected output.

2.B.03 Create software design.

2.B.03.01 Develop a competitive analysis to identify current trends with regard to problem stated from 2.B.01.

2.B.03.02 Design program logic using graphical techniques such as flow charts or storyboards.

2.B.03.03 Design program logic using pseudocode techniques.

2.B.03.04 Determine the technical design describing how a system solution from section 2.B.02 is to work/function.

2.B.03 Performance Examples:

- Students will create a graphical and pseudocode description of a problem to be solved.
- Students will prepare a technical design document describing how a system solution from section 2.B.02 is to work/function.

2.B.04 Demonstrate software implementation.

2.B.04.01 Describe and classify various search engine optimization techniques.

2.B.04.02 Produce internal documentation.

2.B.04.03 Determine programs based on design document from section 2.B.03.

2.B.04.04 Demonstrate use of Extensible Hypertext Markup Language (XHTML) validation.

2.B.04 Performance Examples:

- Students will list steps necessary to implement a program on a given platform.
- Students will develop programs based on design document from section 2.B.03.

2.B.05 Perform software testing.

2.B.05.01 Identify various software testing techniques.

2.B.05.02 Determine the technical tests to be performed based on a “what” document defined in section 2.B.02.

2.B.05.03 Determine browser compatibility issues and user accessibility standards.

2.B.05.04 Evaluate a program based on test plan.

2.B.05 Performance Examples:

- Given a program that has many errors, students will write a test procedure for the program, implement the test program, and document what the errors are and how to correct the errors.
- Students will prepare a technical test plan document describing the testing to be performed based on a **what** document defined in section 2.B.02.

- 2.B.06 Create user software documentation.
2.B.06.01 Determine how the user is to utilize a system solution that has been implemented from section 2.B.04.

2.B.06 Performance Example:

- Students will prepare a technical user guide document describing how the user is to utilize a system solution that has been implemented from section 2.B.04.

- 2.B.07 Publish and maintain software.
- 2.B.07.01 Provide feedback to the development process.
2.B.07.02 Demonstrate methods used to maintain software.
2.B.07.03 Assess release management.
2.B.07.04 Compare and contrast revision control and version control.
2.B.07.05 List the responsibilities of website hosting.
2.B.07.06 Describe methods used to collect and evaluate website traffic using server log data and other feedback.
2.B.07.07 Publish an application.

2.B.07 Performance Examples:

- Students will list steps necessary to register a domain name, publish a web site, secure hosting services, and provide on-going web site maintenance.
- Students will list the procedures for web site Uniform Resource Locator (URL) submission to search engines.
- Students will list steps necessary to distribute a program on a given platform.

- 2.B.08 Demonstrate team and project management skills.
- 2.B.08.01 Determine scope of work to achieve individual and group goals.
2.B.08.02 Develop work breakdown structures.
2.B.08.03 Determine required resources and budget.
2.B.08.04 Compose time requirements.
2.B.08.05 Determine interdependencies within a project management plan.
2.B.08.06 Determine and track critical milestones.
2.B.08.07 Evaluate risks and discuss contingency plan.
2.B.08.08 Participate in project phase review and report project status.
2.B.08.09 Prioritize tasks according to software requirements developed in 2.B.02.

2.B.08 Performance Example:

- Using appropriate project management software, students will complete an assigned project within the given time limit and submit documentation for each phase including scope of the problem to be solved, plan of action, individual responsibilities, flowchart/storyboard, and time requirements.

2.C Programming Concepts

- 2.C.01 Implement concepts fundamental to programming.
- 2.C.01.01 Describe what a computer program is and how it runs.
2.C.01.02 Demonstrate the use of a debugger.
2.C.01.03 Utilize Integrated Development Environments.
2.C.01.04 Demonstrate user defined functions and procedures.
2.C.01.05 Implement programming structures.
2.C.01.06 Differentiate between procedural and object oriented programming.
2.C.01.07 Demonstrate the use of logical operators.
2.C.01.08 Demonstrate the use of relational operators.
2.C.01.09 Demonstrate the use of arithmetic operators.

- 2.C.01.10 Demonstrate the use of compound conditions.
- 2.C.01.11 Demonstrate the use of conditional branching operators.
- 2.C.01.12 Demonstrate iterative loops.
- 2.C.01.13 Characterize the function and operation of compilers and interpreters.
- 2.C.01.14 Incorporate the fundamental data types and their operations.
- 2.C.01.15 Demonstrate the use of an array (list).
- 2.C.01.16 Explain the characteristics and uses of batch processing.
- 2.C.01.17 Utilize built-in functions and libraries.
- 2.C.01.18 Differentiate between sorting algorithms.
- 2.C.01.19 Demonstrate the use of sort routines.
- 2.C.01.20 Incorporate error handling routines.

2.C.01 Performance Examples:

- Students will create small programs using fundamental data types and logical, relational, and arithmetic operators.
- Students will create small programs using arrays (lists) and array (list) processing techniques.
- Students will create small programs using built-in and user defined functions and procedures.

2.C.02 Demonstrate fundamentals of Object Orientated (OO) Programming.

- 2.C.02.01 Develop classes.
- 2.C.02.02 Develop a constructor.
- 2.C.02.03 Demonstrate object instantiation.
- 2.C.02.04 Differentiate between class types such as superclass, subclass, abstract and interface.
- 2.C.02.05 Define encapsulation.
- 2.C.02.06 Define polymorphism.
- 2.C.02.07 Define overloading.
- 2.C.02.08 Define overriding.
- 2.C.02.09 Define inheritance.
- 2.C.02.10 Develop fields.
- 2.C.02.11 Demonstrate the use of instance and class variables.
- 2.C.02.12 Develop methods.
- 2.C.02.13 Differentiate between a constructor and de-constructor.

2.C.02 Performance Examples:

- Students will explain OO terms such as overloading, polymorphism, encapsulation, overriding, and inheritance.
- Students will explain classes and their contents along with objects.

2.C.03 Construct a program.

- 2.C.03.01 Create a menu driven application.
- 2.C.03.02 Create an interactive application.
- 2.C.03.03 Create an application to read from a file.
- 2.C.03.04 Create an application to write to a file.

2.C.03 Performance Examples:

- Students will create programs using good programming style guidelines and run the programs.
- Students will correct errors and warnings (if necessary).

2.D Web Development Concepts

- 2.D.01 Demonstrate fundamentals of Hypertext Markup Language (HTML).
- 2.D.01.01 Differentiate between an XHTML and HTML document.
 - 2.D.01.02 Create an HTML document and launch in a browser.
 - 2.D.01.03 Utilize XHTML tag syntax in accordance with W3C standards.
 - 2.D.01.04 Demonstrate the use of tables.
 - 2.D.01.05 Create absolute and relative hypertext links.
 - 2.D.01.06 Demonstrate the use of internal and external anchors.
 - 2.D.01.07 Compare the pros and cons of frames and I-frames.
 - 2.D.01.08 Create a page using various form elements.
 - 2.D.01.09 Incorporate an image into a web page.
 - 2.D.01.10 Incorporate an audio clip into a web page.
 - 2.D.01.11 Incorporate a video clip into a web page.

2.D.01 Performance Examples:

- Students will create a web page utilizing standard XHTML tags in contemporary use.
- Students will test and debug the page.
- Students will take an existing HTML page and format code using XHTML.
- Students will validate page

- 2.D.02 Demonstrate fundamentals of cascading style sheets (CSS).
- 2.D.02.01 Utilize CSS syntax in accordance with World Wide Web Consortium (W3C) standards.
 - 2.D.02.02 Demonstrate the use of selectors, declarations, properties and values.
 - 2.D.02.03 Differentiate between in-line, internal, and external style sheets.
 - 2.D.02.04 Create and link an external CSS file to website.
 - 2.D.02.05 Differentiate between a class and an id.
 - 2.D.02.06 Demonstrate the use of class and id.
 - 2.D.02.07 Differentiate between relative and absolute positioning.
 - 2.D.02.08 Demonstrate the use of relative and absolute positioning.

2.D.02 Performance Examples:

- Students will create a web page utilizing an external cascading style sheet (CSS) supplied by teacher.
- Students will create new external CSS to redesign given page.

- 2.D.03 Demonstrate fundamentals of JavaScript.
- 2.D.03.01 Demonstrate the use of JavaScript syntax.
 - 2.D.03.02 Differentiate between internal and external JavaScript.
 - 2.D.03.03 Create and link external JavaScript file to website.
 - 2.D.03.04 Implement features such as pop-up windows, rollovers, slideshows, and form verifications using pre-built JavaScript libraries.

2.D.03 Performance Examples:

- Students will create a web page utilizing basic JavaScript functions and techniques such as pop-up windows, rollovers, slideshows, time/date, and form verification.
- Using JavaScript, students will add a clock to an existing HTML document.

2.D.04 Construct a website.

2.D.04.01 Create a template page for website development.

2.D.04.02 Construct a website using a template including various page formats such as home page and content page.

2.D.04.03 Implement a page layout using divs and CSS.

2.D.04.04 Differentiate between website layouts using divs and CSS, tables, frames, and non-CSS.

2.D.04 Performance Examples:

- Students will plan a basic web page template.
- Students will create structure, page layout, site map, and navigational scheme.
- Students will develop content with search engine keywords.

Strand 3: Embedded Academics

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

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

Selected Websites

- 5 Ways to Ace a Job Interview: 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
- Checklist: <http://www.doe.mass.edu/cd/plan/checklist.pdf>
- Career Tech: 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
- 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
- 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

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
- National Foundation for Teaching Entrepreneurship (NFTE): 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

Glossary

Term	Definition
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

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

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.01.01, 2.A.01.04, 2.A.02.01, 2.A.02.02, 2.A.02.03, 2.A.04.01, 2.A.05.01, 2.A.06.02, 2.A.06.03, 2.B.01.01, 2.B.01.06, 2.B.02.02, 2.B.03.01, 2.B.03.04, 2.B.04.02, 2.B.04.03, 2.B.05.02, 2.B.05.01, 2.B.06.01, 2.B.07.03, 2.C.02.01, 2.C.02.02, 2.C.01.05, 2.C.01.14, 2.C.01.20, 2.C.02.10, 2.C.02.12, 2.C.03.01, 2.C.03.02, 2.C.03.03, 2.C.03.04, 2.D.01.02, 2.D.01.05, 2.D.01.08, 2.D.03.03, 2.D.03.04	WHST Grades 9-10 #2 (a-e)	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience’s knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating)
Performance Example: <ul style="list-style-type: none"> • Students will accurately answer open response questions in well-written paragraphs that demonstrate an understanding of various career area topics. 		
2.B.02.02, 2.B.03.01, 2.B.03.04, 2.B.04.02, 2.B.04.03, 2.B.05.02,	WHST Grades 9-10, #4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

2.B.06.01, 2.B.08.04, 2.C.02.01, 2.C.02.02, 2.C.01.05, 2.C.01.15, 2.C.02.10, 2.C.02.12, 2.C.03.01, 2.C.03.02, 2.C.03.03, 2.C.03.04, 2.D.01.02, 2.D.01.05, 2.D.01.08, 2.D.03.03, 2.D.03.04, 2.D.04.02	WHST Grades 9-10, #4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
<p>Performance Example:</p> <ul style="list-style-type: none"> Considering audience and task, students will write clearly and effectively about technical procedures utilizing domain-specific vocabulary and phrases. 		
2.B.03.02, 2.B.03.03, 2.B.07.07, 2.B.08.06, 2.D.01.04, 2.D.04.01, 2.D.04.02, 2.D.04.03	WHST Grades 9-10, #6	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>Performance Example:</p> <ul style="list-style-type: none"> Students will utilize technology in the career area setting to accurately and effectively design software and websites. 		
2.A.01.02, 2.A.07.02, 2.A.08.03, 2.B.01.04, 2.B.03.01, 2.B.04.01, 2.B.05.03, 2.B.07.04, 2.C.01.13	WHST Grades 9-10, #7	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>Performance Example:</p> <ul style="list-style-type: none"> Students will perform a technical task that entails the classifying or comparing and contrasting of career area topics and explain in writing how they reached their given conclusion and what sources helped lead them to this conclusion. 		
2.B.01.05	WHST Grades 9-10, #8	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>Performance Example:</p> <ul style="list-style-type: none"> As part of a group project, students will research how to perform a specific technical task and describe the process and industry standards related to this task. 		

2.A.01.01, 2.A.01.03, 2.A.01.04, 2.A.02.01, 2.A.02.02, 2.A.02.03, 2.A.03.05, 2.A.03.06, 2.A.03.07, 2.A.04.01, 2.A.04.02, 2.A.04.03, 2.A.05.01, 2.A.05.02, 2.A.06.01, 2.A.06.02, 2.A.07.01, 2.A.08.01, 2.A.08.02, 2.B.01.06, 2.B.05.01, 2.B.07.02, 2.C.01.06, 2.C.01.18, 2.C.02.04, 2.C.02.13, 2.D.01.01, 2.D.03.05, 2.D.02.07, 2.D.03.02	WHST Grades 9-10, #9	Draw evidence from informational texts to support analysis, reflection, and research.
Performance Example: <ul style="list-style-type: none"> In order to demonstrate knowledge of a given fundamental technical concept, students will compose an essay that accurately describes the concept utilizing appropriate evidence. 		
2.A.01.03, 2.A.01.04, 2.A.02.01, 2.A.04.01, 2.A.06.01, 2.A.08.02, 2.B.05.01, 2.C.01.17, 2.D.01.03, 2.D.02.01	RST Grades 9-10, #1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
Performance Example: <ul style="list-style-type: none"> In order to exhibit their knowledge of career area concepts, students will refer to specific texts and documents when discussing or writing about the aforementioned concepts. 		
2.A.01.01, 2.A.02.03, 2.A.04.01, 2.A.05.01, 2.A.06.02, 2.B.05.03	RST Grades 9-10, #2	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.
Performance Example: <ul style="list-style-type: none"> Orally or in writing, students will provide a ten percent summary of required career area reading in order 		

to demonstrate their understanding of technical concepts.		
2.A.07.01, 2.A.07.02	RST Grades 9-10, #4	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.
Performance Example: <ul style="list-style-type: none"> Students will read technical texts and documents and record two-column notes on domain-specific words and phrases. 		
2.A.01.02, 2.A.04.02, 2.A.04.03, 2.A.05.02, 2.A.08.01, 2.A.08.03, 2.B.04.01, 2.C.01.06, 2.C.01.13, 2.C.01.18, 2.C.02.04, 2.C.02.13, 2.D.01.01, 2.D.02.03, 2.D.02.07, 2.D.03.02, 2.D.04.04	RST Grades 9-10, #5	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
Performance Example: <ul style="list-style-type: none"> Utilizing a graphic organizer such as a Venn diagram, students will explore the relationship between pairs of various technical terms. 		
2.A.01.05, 2.B.03.02, 2.B.03.03, 2.B.07.05,	RST Grades 9-10, #7	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.
Performance Example: <ul style="list-style-type: none"> In order to not only demonstrate their understanding of technical concepts, but also to break these concepts down to their most basic level, students will create presentations that rely on visuals as well as words. 		
2.A.02.02, 2.B.01.02, 2.B.05.04, 2.B.07.03	RST Grades 9-10, #8	Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.
Performance Example: <ul style="list-style-type: none"> Students will apply knowledge gained from informational texts to the performance of a technical task when appropriate. 		
2.B.01.03, 2.B.07.04	RST Grades 9-10, #9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
Performance Example: <ul style="list-style-type: none"> When performing technical tasks, students will rely not only upon the knowledge gained from reading informational texts, but also from knowledge gained through the completion of previous tasks as well as knowledge gained through observation. Students will assess what knowledge is to be applied to the task. 		
2.B.08.07	RST Grades 11-12, #8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

<p>Performance Example:</p> <ul style="list-style-type: none"> When working on a group project, students will check their own work against existing informational texts and documents in order to maximize chances of the best possible outcome. 		
2.B.08.05	RST Grades 11-12, #9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
<p>Performance Example:</p> <ul style="list-style-type: none"> When working on a group project, students will draw on a variety of existing informational sources in order to develop an effective project management plan. 		
2.A.01.01, 2.A.02.01, 2.A.04.01, 2.A.05.01, 2.A.06.02, 2.A.07.01, 2.B.02.01, 2.B.05.01, 2.B.07.01, 2.B.07.06	SL Grades 9-10, #1 a.	<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>a. Come to discussions prepared having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> In group discussions, students will explain their understanding of technical information or tasks by summarizing the process(es) using domain-specific words and phrases and by referring to textual evidence. 		
2.B.08.01, 2.B.08.02	SL Grades 9-10, #1 b.	<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>b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, and presentation of alternate views), clear goals and deadlines, and individual roles as needed.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> When working on a group project, students will assign roles and set S.M.A.R.T. goals in a diplomatic manner. 		
2.A.02.02, 2.B.07.01, 2.B.07.03, 2.B.08.03, 2.B.08.05, 2.B.08.06, 2.B.08.07, 2.B.08.08, 2.B.08.09	SL Grades 9-10, #1 c.	<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>c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> When working on a group project, especially one that simulates a genuine workplace environment, students will continually monitor and assess S.M.A.R.T. goals in order to effectively bring the project to a successful conclusion. 		
2.B.07.01, 2.B.08.03, 2.B.08.05, 2.B.08.06, 2.B.08.07, 2.B.08.08,	SL Grades 9-10, #1 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>d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when</p>

2.B.08.09		warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
Performance Example: <ul style="list-style-type: none"> When working on a group project, especially one that simulates a genuine workplace environment, students respectfully listen and respond to the viewpoints of others and come to a collaborative agreement about how to best resolve any conflicts. 		
2.A.01.05	SL Grades 9-10, #2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
Performance Example: <ul style="list-style-type: none"> In examining Information Technology's role in the workplace and community, students will present findings orally and use various forms of media to augment presentation. 		
2.A.01.02, 2.A.01.05, 2.A.02.03, 2.A.03.03, 2.A.03.05, 2.A.03.06, 2.A.03.07, 2.A.04.02, 2.A.04.03, 2.A.05.02, 2.A.07.01, 2.A.07.02, 2.A.08.01, 2.A.08.03, 2.B.02.01, 2.B.04.04, 2.B.07.02, 2.B.07.05, 2.B.07.06, 2.B.08.08, 2.C.02.03, 2.C.01.01, 2.C.01.02, 2.C.01.04, 2.C.01.15, 2.C.01.16, 2.C.01.18, 2.C.01.19, 2.C.02.04, 2.C.02.05,	SL Grades 9-10, #4	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.
2.C.02.06, 2.C.02.07, 2.C.02.08, 2.C.02.09, 2.C.02.11, 2.C.02.13, 2.D.01.01, 2.D.01.04, 2.D.01.06, 2.D.01.07, 2.D.02.02,	SL Grades 9-10, #4	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.

2.D.03.05, 2.D.02.06, 2.D.02.07, 2.D.02.08, 2.D.03.01, 2.D.03.02, 2.D.04.04		
<p>Performance Example:</p> <ul style="list-style-type: none"> In a group or individually, students will cite to the instructor or the class an understanding of a technical task being performed in the career area setting by summarizing the process using domain-specific words and phrases. 		
2.A.01.05, 2.A.03.01, 2.A.03.04, 2.A.03.05, 2.A.07.02, 2.B.03.02, 2.B.03.03, 2.B.04.04, 2.B.07.05, 2.D.01.09, 2.D.01.10, 2.D.01.11	SL Grades 9-10, #5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
<p>Performance Example:</p> <ul style="list-style-type: none"> When creating and presenting programs and designs, students will incorporate digital media into their work. 		
2.C.01.01, 2.C.01.16, 2.C.02.05, 2.C.02.06, 2.C.02.07, 2.C.02.08, 2.C.02.09, 2.D.01.07	L Grades 9-10, # 1 a. & b.	Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. <ul style="list-style-type: none"> Use parallel structure.* Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
<p>Performance Example:</p> <ul style="list-style-type: none"> When participating in formal or informal class discussions or presentations, or when working on a technical writing task, students will accurately employ Standard English conventions to their speech or writing. 		
2.A.04.02, 2.A.04.03, 2.A.05.02, 2.B.02.01, 2.B.07.06, 2.C.01.01, 2.C.01.06, 2.C.01.13, 2.C.01.16, 2.C.01.18, 2.C.02.04, 2.C.02.05, 2.C.02, 06, 2.C.02.07, 2.C.02, 08, 2.C.02. 09,	L Grades 9-10, #6	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.

2.C.02.13, 2.D.01.01, 2.D.01.07 2.D.02.05, 2.D.02.07, 2.D.03.02		
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will use domain-specific words and phrases accurately when performing technical tasks/procedures in the career area setting, whether working with classmates, instructors, or clients. 		

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.A.01.03	9-12.A.CED.4 9-12.N-Q.3a MA.9-12.G.MG.4	<p>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.*</p> <p>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.*</p> <p>Use dimensional analysis for unit conversion to confirm that expressions and equations make sense.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Student will be able to calculate and analyze results of electrical static discharge 		
2.A.03.02	9-12.S.ID.5 9-12.S.CP.9 (+)	<p>Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends</p> <p>Use permutations and combinations to compute probabilities of compound events and solve problems.*</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will be able to calculate the number of passwords available with a given password length. 		
2.A.04.03 2.A.04.05	9-12.N-Q.1 7.EE.3 7.RP.1	<p>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.*</p> <p>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.</p> <p>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</p>

	MA.9-12.G.MG.4	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 Use dimensional analysis for unit conversion to confirm that expressions and equations make sense.
Performance Example: <ul style="list-style-type: none"> Student will be able to apply correct unit conversions to calculate transfer rates and file sizes while working with digital image files 		
2.A.07.04	9-12.F.IF.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$. (Not necessarily the function notation rather the interdependency of the data.)
Performance Example: <ul style="list-style-type: none"> Student will be able to classify data base queries and analyze the results given the relationships between tables as one-to-one or one-to-many. 		
2.B.01 2.B.02	9-12.S.IC.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*
	9-12.S.IC.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*
	9-12.S.IC.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*
	9-12.S.IC.4	Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*
2.B.01 2.B.02	9-12.S.IC.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*
	9-12.S.IC.6	Evaluate reports based on data.*
	7.RP.1	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"> Student will design a survey to determine technical requirements to satisfy system solutions for a customer. Student will be able to compute each component's technical needs to create a properly designed system. 		

<ul style="list-style-type: none"> Student will perform and analyze troubleshooting techniques and use results to formulate possible causes and solutions to a problem. 		
2.B.08	7.RP.1 9-12.F-BF.1c (+) 9-12.S.MD.7 (+)	<p>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</p> <p>Compose functions. For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time. (In this case time management aspects needed to determine project timetables)</p> <p>Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).*</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Student will be able to calculate needs, resources, and costs to complete a software development project. 		
2.C.01	CVTE 9-12.N.VM.6 (+)	<p>Apply Boolean Algebra concepts to design logical and relational operators and Number theory of Binary, Octal, and Hexadecimal number systems</p> <p>Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> Student will be able to write a program correctly using logical and relational operators along with conditional branching operators. Student will be able to write a sort routine using built in functions and user defined procedures. 		
2.D.04	9-12.G.CO.1 7.G.2 9-12.G.MG.1	<p>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.</p> <p>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> <p>Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*</p>

Embedded Science and Technology/Engineering

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
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2.B.02	Physical Science SIS 1	<p>SIS1. Make observations, raise questions, and formulate hypotheses.</p> <p>Observe the world from a scientific perspective. Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge. Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Student will meet with a customer who is seeking a computer program to resolve a problem. Student will then research the problem and determine if the software market could use a new program. Utilizing this information, the student will develop a hypothetical solution to the customer’s problem and develop a potential plan to address it. 		
2.B.03	Physical Science SIS 3	<p>SIS3. Analyze and interpret results of scientific investigations.</p> <p>Present relationships between and among variables in appropriate forms. Represent data and relationships between and among variables in charts and graphs. Use appropriate technology (e.g., graphing software) and other tools. Use mathematical operations to analyze and interpret data results. Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis. State questions raised by an experiment that may require further investigation.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Using the same customer problem from framework 2.B.02 above, students will now design a software package to resolve the customer’s software needs. As previously stated in framework 2.B.02’s performance example, the student will first engage in market research to determine if a new software package should even be created. For example, if there already is an older version of the software available, then dependent on the license it is under, the student’s “company” can create a licensing situation where this older software can be used within a newer program and then re-market it. However, if no previous program exists or if the company who owns the license would not permit its use within another program, then the student will have to create a new program from the ground-up. Next, the students will have to present their data in a visual format, utilizing graphs, flow charts or other graphic organizers to demonstrate the need for their new or newer program in the current software market, making sure to use basic statistics to indicate the potential profitability of their new program to themselves. Finally, they will have to submit a brief written report indicating how their new software will attend to the problem posed by their client, how it will affect the software market and how to interpret their graphical information. 		
2.B.04	Physical Science SIS 2	<p>SIS2. Design and conduct scientific investigations.</p> <p>Articulate and explain the major concepts being investigated and the purpose of an investigation. Select required materials, equipment, and conditions for conducting an experiment. Identify independent and dependent variables. Write procedures that are clear and replicable. Employ appropriate methods for accurately and consistently making observations making and recording measurements at appropriate levels of precision collecting data or evidence in an organized way</p>

		Properly use instruments, equipment, and materials. Follow safety guidelines.
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will be given an assignment where they must first list the steps necessary to implement a computer program. Then, they will be given documentation from a previously written computer program where they must classify various search optimization techniques. They will also have to organize the documentation for this program which will be supplied to the students, but out of order. 		
2.B.05	Physical Science SIS 2	<p>SIS2. Design and conduct scientific investigations.</p> <p>Articulate and explain the major concepts being investigated and the purpose of an investigation. Select required materials, equipment, and conditions for conducting an experiment. Identify independent and dependent variables. Write procedures that are clear and replicable. Employ appropriate methods for accurately and consistently making observations making and recording measurements at appropriate levels of precision collecting data or evidence in an organized way Properly use instruments, equipment, and materials. Follow safety guidelines.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will be given a test procedure and a test program. They will need to evaluate the program according to the test plan. 		
2.B.07	Physical Science SIS 4	<p>SIS4. Communicate and apply the results of scientific investigations.</p> <p>Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations. Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation. Explain diagrams and charts that represent relationships of variables. Construct a reasoned argument and respond appropriately to critical comments and questions. Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings. Use and refine scientific models that simulate physical processes or phenomena.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> In groups of 3-4, students will design their own website. Each group will have assigned positions in terms of who is involved in the concept development/management, concept/website design/implementation, and website maintenance. Each group will first develop its own website and then maintain the website. All work on their website will be logged in a group journal, but each student must submit their own entries to it to receive full-credit. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
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2.C.01	Science Mathematical Skills	<p>Students are expected to know the content of the Massachusetts Mathematics Curriculum Framework, through grade 8. Below are some specific skills from the Mathematics Framework that students in this course should have the opportunity to apply:</p> <p>Construct and use tables and graphs to interpret data sets. Solve simple algebraic expressions. Perform basic statistical procedures to analyze the center and spread of data. Measure with accuracy and precision (e.g., length, volume, mass, temperature, time) Convert within a unit (e.g., centimeters to meters). Use common prefixes such as milli-, centi-, and kilo-. Use scientific notation, where appropriate. Use ratio and proportion to solve problems.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> • Create programs using: 1) fundamental data types and logical, relational, and arithmetic operators; 2) array (list) processing techniques; 3) built-in and user defined functions and procedures. 		

Technology/Engineering

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Technology/Engineering Learning Standard
2.A.01	Technology/Engineering 1.2	Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students will research one area of Information Technology from its inception to the current day and will create a detailed timeline in which they explain its effect on society. This must include both positive and negative outcomes (where applicable). 		
2.A.03	Technology/Engineering 1.5	Interpret plans, diagrams, and working drawings in the construction of prototypes or models.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students will design and publish an autobiographical web page incorporating multimedia and graphic components. The graphic components must consist of at least one image captured through a digital camera, one image manipulated using a graphic tool, one digital video image, and one audio file. 		
2.A.04	Technology/Engineering 6.3	Explain how the various components and processes of a communication system function.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students will create graphic organizers where they organize and define the difference between the internet and intranet as well as the difference between network types. 		
2.B.01	Technology/Engineering 1.1	Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students will interview a fictional customer with a computer problem. They must identify the specific problem from the information provided by the customer, research the problem, devise a possible solution, test the solution, and provide feedback to the customer about the problem and potential solution. 		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

CertiPort MTA Certifications

Development (Programming) Exams

- Software Development Fundamentals (VB or C#)
- Web Development Fundamentals (VB or C#)
- Windows Development Fundamentals
- .Net Fundamentals
- Mobile Apps Development Fundamentals
- Gaming Development Fundamentals
- HTML 5 Application Development Fundamentals

Database Administration Exam

- Database Administration Fundamentals

IT Pro Exams

- Networking Fundamentals
- Windows OS Fundamentals
- Security Fundamentals
- Server Admin Fundamentals

CompTIA Certifications (<http://certification.comptia.org/getCertified/certifications.aspx>)

- A+
- CDIA+
- CTP+
- CTT+
- Linux+
- Network+
- PDI+
- Project+
- Security+
- Storage+
- Server+
- Cloud Essentials
- Green IT
- Healthcare IT
- IT for Sales
- IT Fundamentals

Other

Reference Materials

- Instructors and Their Jobs, W.R. Miller and M.F. Miller, American Technical Publishers, 2002
- Improving Student Learning, Lee Jenkins, ASQC Quality Press, 1997
- Teaching Your Occupation to Others, Paul A. Bott, Allyn and Bacon, 1998
- Learning to Program with Alice, Dann Cooper & Pausch, Pearson Prentice Hall, 2009
- Programming Logic & Design, Tony Gaddis, Addison-Wesley, 2010
- Computer Concepts 2010, Parsons OJA, Course Technology Cengage Learning, 2010
- Object Oriented Systems Design, Edward Yourdon, Yourdon Press, 1994
- Software Engineering: A Practitioner's Approach, Roger S. Pressman, McGraw-Hill, 1982
- Information Architecture for the World Wide Web, Peter Morville & Louis Rosenfeld, O'Reilly, 2007
- Programming PHP, Rasmus Lerdorf & Kevin Tatroe, O'Reilly, 2002
- Python Programming for the Absolute Beginner, Michael Dawson, Course Technology Cengage Learning, 2008
- HTML, XHTML, and XML, Patrick Carey, Course Technology Cengage Learning, 2010
- Information Technology Project Management, Kathy Schwalbe, Thompson Course Technology, 2006
- Project Management A Systems Approach to Planning, Scheduling, and Controlling, Harold Kerzner, Van Nostrand Reinhold, 1989
- HTML, JavaScript, and Advanced Internet Technologies Basics, Barksdale – Turner, 2006
- The Media of Mass Communication, John Vivian, Allyn & Bacon, 2011
- JavaScript, Patrick Carey & Frank Canovatchel, Thompson Course Technology, 2006
- Succeeding with Technology Computer System Concepts for Real Life, Ken Baldauf & Ralph M. Stair, Course Technology Cengage Learning, 2009
- Introduction to Computing and Programming in Python A Multimedia Approach, Mark Guzdial, Peason Prentice Hall, 2005
- Beginning Java Game Programming, Jonathan S. Harbour, Thompson Course Technology, 2008
- Head First C#, Andrew Stellman & Jennifer Greene, O'Reilly, 2008
- Learning Computer Programming It's Not About Languages, Mary E. Farrell, Charles River Media, Inc., 2002

Related National, Regional, and State Professional Organizations

- Business Professionals of America (BPA)
- CSTA – Computer Science Teachers Association

Student Organizations

- Skills USA www.maskillsusa.org

Selected Websites

- www.w3schools.com
- www.lynda.com
- www.csunplugged.org
- www.alice.org
- www.python.org
- <http://msdn.microsoft.com/en-us/library/cc178930.aspx>
- <http://xbox.create.msdn.com/en-US/>