



*Vocational Technical Education Framework*



Construction Occupational Cluster

***Electricity (VELEC)***

CIP Code 460302

June 2014

**Massachusetts Department of Elementary and Secondary Education**

**Office for Career/Vocational Technical Education**

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# Acknowledgements

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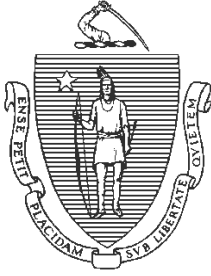
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## Commissioner's Letter

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

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Mitchell D. Chester, Ed.D.  
Commissioner

July 2014

Dear Colleagues,

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

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

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

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

Sincerely,

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

# Guiding Principles

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## Overview & Guiding Principals

### 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.

## Guiding Principles

The Guiding Principles section contains the following two sections:

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

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

#### Strand One:

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

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

#### Strand Two:

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

- The Technical Knowledge and Skills (Strand Two) section contains standards specific to the particular vocational program; suffix “a” (as common to all programs) and suffix “c” (as common within a cluster) have been removed.
- Each VTEF Strand Two begins with safety and health knowledge and skills specific to the particular vocational program.

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

### Strand Three:

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

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

### Strand Four:

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

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

### Strand Five:

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

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

### Strand Six

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

## Appendix<sup>1</sup>

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

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

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

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

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## Organization of the Frameworks – Strand Two

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

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

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

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

2.A.01 Performance Example:

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

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

2.A.02 Performance Example:

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

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

2.A.03 Performance Example:

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

There are additional changes to some of the Frameworks Strand Two (Technical Knowledge and Skills). Specifically, Strand Two of the Frameworks for Animal Science, Environmental Science and Technology and Horticulture begin with core standards required for all participants in the programs, followed by a series of standards organized in concentrations. For example, Strand Two

of the Horticulture Framework begins with the core standards required of all Horticulture students (Topics 2.A through 2.I). These standards are followed by the three concentrations: Arboriculture (Topics 2.J through 2.L), Greenhouse Management and Floriculture (Topics 2.J. through 2.L) and Landscape and Turf Management (Topics 2.M through 2.Q).

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

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

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

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

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

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

2.CC.01 Perform appropriate cylinder Head Repair.

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

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

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

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

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

2.B.04 Performance Examples:

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



# Construction Occupational Cluster

## Electricity Framework (VELEC)

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

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

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

1. A.01 Performance Examples:

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

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

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

1. A.02 Performance Examples:

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

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

1. A.03 Performance Example:

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

### *Selected Websites*

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

## Strand 2: Technical Knowledge and Skills

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### 2.A Shop Safety & Regulations

- 2.A.01 Describe and demonstrate safety techniques and methods with tools & shop procedures.
- 2.A.01.01 Describe and demonstrate safety procedures and techniques using hand and power tools.
  - 2.A.01.02 Identify the hazard, recognize the proper practice and describe and demonstrate methods of safely working with electricity.
  - 2.A.01.03 Define Arc flash according to the National Fire Protection Association (NFPA-70 and NFPA 70E).
  - 2.A.01.04 Explain and demonstrate electrical safety requirements per NFPA 70E.
  - 2.A.01.05 Identify and demonstrate basic safety procedures that apply to ladder safety.
  - 2.A.01.06 Differentiate a confined space from an enclosed space.
  - 2.A.01.07 Describe the regulations for working in confined space.
  - 2.A.01.08 Describe the minimum requirements for safe entry.

2.A.01 Performance Examples:

- Student will participate in daily /weekly “Toolbox Safety Talks” and will pass a written and performance test for all shop tools and equipment.

### 2.B Reading Technical Drawings and Blueprints

- 2.B.01 Read and interpret prints.
- 2.B.01.01 Describe the basic layout of a set of prints as well as the importance of the accompanying job specifications document.
  - 2.B.01.02 Identify and define basic print terms, abbreviations, line types, symbols and notes.
  - 2.B.01.03 Interpret and accurately follow drawing dimensions.
  - 2.B.01.04 Convert measurements from a print using an architect’s scale.
  - 2.B.01.05 Define and interpret floor plans, elevations, sections, details, ceiling plans, and finish schedules.
  - 2.B.01.06 Discuss and demonstrate the use of estimating methods in pricing jobs using drawings/prints.
  - 2.B.01.07 Use a drawing to design, develop and complete material quantity takeoff sheets, indicating quantities and types of material required for installation.
  - 2.B.01.08 Use a Uniform Permit to discuss how state and/or local code requirements apply to prints.
  - 2.B.01.09 Compare the layout on the drawing to the code required minimum requirements and identify omissions.

2.B.01 Performance Examples:

- Student will perform shop/job site projects/work from given sets of prints/drawings.
- Student will develop a material quantity takeoff for given project/job.
- Student will develop a cost estimate from material quantity takeoff for given project/job.
- Student will prepare an application for a given electrical permit.

## 2.C Tools and Techniques in Fastening Objects

2.C.01 Install different types of fasteners.

2.C.01.01 Explain and demonstrate the use of various trade related threaded and non-threaded fasteners.

2.C.01.02 Explain and demonstrate the use of and type of anchors.

2.C.01 Performance Example:

- Student will install a steel anchor in concrete.
- When provided with a piece of electrical equipment, the student will determine appropriate mounting technique and obtain proper fastener. Student will select and attach electrical equipment using proper fasteners and technique.

2.C.02 Demonstrate inspection and use of fastening power tools according to current safety and industry standards.

2.C.02.01 Use and maintain fastening, sawing, drilling and boring tools.

2.C.02.02 Use and maintain portable drills, portable circular saws, screw guns and equipment.

2.C.02 Performance Examples:

- Student will demonstrate the approved use and maintenance of power tools used to fasten boxes to concrete/masonry.
- Identify and demonstrate the use of the appropriate threaded, non-threaded fastener or anchor to fasten a box to a concrete or masonry surface.

## 2.D Concepts of electrical theory

2.D.01 Explain basic concepts of AC/DC electrical theory.

2.D.01.01 Compare and distinguish between conductors and insulators.

2.D.01.02 Explain the relationship between voltage, current, and resistance

2.D.01 Performance Example:

- Student will draw a sine wave showing where voltage peak is on an A/C circuit and compare it to the peak of a D/C circuit.

2.D.02 Define voltage and identify the ways in which it can be produced.

2.D.02.01 Define the units of measurement that are used to measure the properties of electricity.

2.D.02.02 Calculate and apply an unknown value by using Ohm's law formula.

2.D.02.03 Define voltage.

2.D.02 Performance Examples:

- Student will describe the basic characteristics of a series/parallel and combination circuit.
- Student will calculate the voltage, amperage, resistance and wattage of a circuit using Ohms law from given project.

## 2.E Electrical test equipment.

- 2.E.01 Use common meters and tools to measure electrical values, demonstrating the ability to select the proper equipment, test it, use proper personal protective equipment, and select the proper range.
- 2.E.01.01 Perform measurement of current.
  - 2.E.01.02 Perform measurement of voltage.
  - 2.E.01.03 Perform measurement of resistance.
  - 2.E.01.04 Describe and demonstrate the operation of a circuit tracer.
  - 2.E.01.05 Determine the continuity of a circuit.

2.E.01 Performance Example:

- Student will describe and demonstrate the uses of Volt/Ohm and Ampere meters on given devices, including explaining and demonstrating the proper safety practices and protective equipment.

## 2.F Massachusetts Electrical Code (MEC) & Code of Massachusetts Regulations MGL and (CMR)

- 2.F.01 Explain the purpose and history of the National Electrical Code (NEC) and the Massachusetts Electrical Code (MEC) amendments.
- 2.F.01.01 Describe the layout of the Massachusetts Electrical Code (MEC).
  - 2.F.01.02 Demonstrate how to navigate the MEC book.
  - 2.F.01.03 Identify and summarize the MGL's and CMR's as they apply to the electrical trade.
  - 2.F.01.04 Locate appropriate Massachusetts Electric Code Amendments (527 CMR 12).

2.F.01 Performance Examples:

- Student will describe the topic of each of the 9 chapters in the Massachusetts Electrical Code (MEC).
- Student will determine the appropriate article of the Massachusetts Electrical Code MEC for a specific wiring method, and apply to given project.
- Student will describe the value of fine print notes and explain how they apply to given project.
- Student will explain how changes to the MEC are identified.
- Describe the difference between the National Electrical Code and the Massachusetts Electrical Code.

- 2.F.02 State appropriate Electrical Board of Examiners regulations (527 CMR 237).
- 2.F.02.01 Describe the MEC Licensing requirements.
  - 2.F.02.02 Describe the continuing license renewal requirements.

2.F.02 Performance Example:

- Student will describe what licensed electricians must do to renew their license.

- 2.F.03 State the requirements of the MEC and tables.
- 2.F.03.01 Determine conductor requirements.
  - 2.F.03.02 Determine raceway requirements.
  - 2.F.03.03 Determine electrical box requirements.

- 2.F.03.04 Describe the purpose of ground-fault circuit interrupters (GFCI) and arc-fault circuit interrupters (AFCI) and indicate where they must be installed.
- 2.F.03.05 Identify the circuit loads, number of circuits required, and installation requirements.
- 2.F.03.06 Compute branch circuit loads and define branch circuit requirements.

- 2.F.03 Performance Example:
  - Student will calculate a branch circuit load from given project.

## **2.G Raceways, boxes, and fittings.**

- 2.G.01 Installation of raceways and fittings.
  - 2.G.01.01 Select various types and sizes of raceways, fittings, and supports.
  - 2.G.01.02 Perform the proper methods of bending raceway.
  - 2.G.01.03 Cut, ream and thread raceways.
  - 2.G.01.04 Describe the purpose of conduit bodies.
  - 2.G.01.05 Install raceways and fittings on various surfaces.

- 2.G.01 Performance Example:
  - Student will size and install a raceway for given project.

- 2.G.02 Install electrical boxes.
  - 2.G.02.01 Describe the different types of nonmetallic and metallic boxes.
  - 2.G.02.02 Explain how boxes are selected and installed.
  - 2.G.02.03 Install boxes on various surfaces.

- 2.G.02 Performance Examples:
  - Student will install a box on a finished surface from given project.
  - Student will install a box in a finished surface from given project.
  - Student will identify the requirements for boxes that support luminaires.
  - Student will identify the requirements for boxes that support paddle fans.
  - Student will perform box fill calculations on given project.

## **2.H Fundamentals of conductors and cables.**

### **2.H.01 Installation of conductors.**

- 2.H.01.01 Describe and use the various sizes and gauges of wire in accordance with American Wire Gauge (AWG) standards.
- 2.H.01.02 Identify and use insulation types according to conditions and applications.
- 2.H.01.03 List voltage ratings of conductors.
- 2.H.01.04 Read and identify markings conductors.
- 2.H.01.05 Select electrical conductors for specific applications.
- 2.H.01.06 Demonstrate how to size conductors for a load.
- 2.H.01.07 Demonstrate and explain the purpose of de-rating conductors.
- 2.H.01.08 Describe the different conductors.
- 2.H.01.09 Describe the color coding of insulation.
- 2.H.01.10 Demonstrate the use of equipment and procedure for pulling wire through raceways.

#### **2.H.01 Performance Example:**

- Student will calculate wire size, identify application and installed through raceway.

### **2.H.02 Perform conductor terminations.**

- 2.H.02.01 Prepare conductor ends for terminations and splices.
- 2.H.02.02 Select and install lugs and connectors onto conductors.
- 2.H.02.03 Describe and apply splicing techniques.
- 2.H.02.04 Splice conductors using solderless connectors.
- 2.H.02.05 Demonstrate how to use hand and power crimping tools.
- 2.H.02.06 Describe and apply crimping techniques.
- 2.H.02.07 Insulate a splice joint.

#### **2.H.02 Performance Example:**

- Student will splice various solderless connections to different size wire for given project.

### **2.H.03 Install cables.**

- 2.H.03.01 Identify and apply different cable markings.
- 2.H.03.02 Secure and support cables.
- 2.H.03.03 Terminate cables using proper fittings.
- 2.H.03.04 Prepare cables for installation.

#### **2.H.03 Performance Example:**

- Student will prepare conductor for termination, strip appropriate insulation from end of conductor, bend conductor end to terminate under screw termination, and torque screw to manufacturers' specifications on a given project.

## **2.I Power and distribution of electricity**

### **2.I.01 Install electrical services.**

- 2.I.01.01 Describe how to determine electric service requirements for dwellings.
- 2.I.01.02 Describe and demonstrate the grounding requirements for services.
- 2.I.01.03 Calculate and size service-entrance equipment.



2.I.01.04 Install main disconnect switches, panel-boards, and overcurrent protection devices.

- 2.I.01 Performance Example:
- Student will calculate the service size for a residential dwelling.
  - Student will select proper wire size and develop a material takeoff list for the service size calculated.
  - Student will select and describe (or demonstrate) the proper grounding method for the service calculated

2.I.02 Size and install overcurrent protection.

- 2.I.02.01 Articulate the importance and necessity of overcurrent protection in electrical circuits.
- 2.I.02.02 Define the terms associated with fuses and circuit breakers.
- 2.I.02.03 Describe the operation of a circuit breaker and fuse.
- 2.I.02.04 Select the most suitable overcurrent device for the application.
- 2.I.02.05 Describe the operation of single-element and time-delay fuses.

- 2.I.02 Performance Example:
- Student will explain the use of time delay fuses.
  - Student will explain how a circuit breaker operates and who shall reset after tripping.
  - Given several values, the student will select the proper breaker for the application.
  - Student will describe the safety risks associated with improper overcurrent replacement.

2.I.03 Size and install transformers.

- 2.I.03.01 Compute transformer sizes for various applications.
- 2.I.03.02 Identify and define different types of transformers.
- 2.I.03.03 Describe the purpose and methods of grounding transformers.
- 2.I.03.04 Identify power transformer connections.
- 2.I.03.05 Calculate and install overcurrent protection for transformers.

- 2.I.03 Performance Examples:
- Student will calculate the loads for a single family dwelling from given project.
  - Student will size the main overcurrent protective device from given project.
  - Student will install the main overcurrent device in its proper location from given specifications.

## 2.J Fundamentals of motors and motor controls.

2.J.01 Install motors.

- 2.J.01.01 Define terms relating to motors.
- 2.J.01.02 Explain and demonstrate how the direction of a three-phase motor is reversed.
- 2.J.01.03 Describe the methods for determining various motor connections.

- 2.J.01 Performance Example:
- Student will reverse a three phase motor using a reversing contactor.

2.J.02 Install motor controls.

- 2.J.02.01 Draw basic wiring schematic w/controls.
- 2.J.02.02 Describe the operating principles of motor and motor controls.
- 2.J.02.03 Demonstrate the operating principles of motor controls and control circuits.

- 2.J.02.04 Interpret motor control diagrams and schematics.
- 2.J.02.05 Size and select thermal overload relays and other protective devices for motor controls.
- 2.J.02.06 Describe the operating principles of contactors and relays.
- 2.J.02.07 Describe manual, automatic and semi- automatic control circuits.
- 2.J.02.08 Identify and state the functions of limit switches and relays.

2.J.02 Performance Examples:

- Student will draw a schematic diagram for a stop/start motor control circuit.
- Student will convert the schematic diagram to a wiring diagram, and select the controls to match the wiring diagram and install the listed controls and wire them to the schematic diagram.

**2.K Fundamentals of grounding and bonding.**

- 2.K.01 Size and install grounding and bonding system.
  - 2.K.01.01 Distinguish between a short circuit and a ground fault.
  - 2.K.01.02 Distinguish between system grounding and equipment grounding.
  - 2.K.01.03 Explain and demonstrate the function of the grounding electrode system and determine which grounding electrodes shall be used.
  - 2.K.01.04 Size the equipment grounding conductor for raceways and equipment.
  - 2.K.01.05 Explain and demonstrate the function of the main bonding jumper in the grounding system and size the main bonding jumper for various applications.
  - 2.K.01.06 Demonstrate effectively grounded and its importance in clearing ground faults and short circuits.
  - 2.K.01.07 Explain the terms ground, grounded conductor, bonding conductor, equipment grounding conductor, supplemental ground, supplementary ground, and describe the various ground layout schemes.

2.K.01 Performance Examples:

- Student will size a supplemental grounding electrode conductor for a 100 amp service and install the supplemental grounding electrode.
- Student will terminate the grounding electrode conductor to the grounding electrode.

**2.L Elementary use of luminaires and luminaire controls.**

- 2.L.01 Install various lighting and luminaire controls.
  - 2.L.01.01 Identify and apply basic occupancy sensors, photoelectric sensors, and dimmers used to control lighting circuits and describe how each device operates.
  - 2.L.01.02 Identify different kinds of lamps and define the advantages and disadvantages of each type.
  - 2.L.01.03 Identify and install various types of lighting fixtures (luminaires).
  - 2.L.01.04 Classify lighting fixtures by layout, location, fixture type, and type of service.
  - 2.L.01.05 Demonstrate and state the functions and rating of single-pole, double pole, three-way, four-way, and dimmer switches.
  - 2.L.01.06 Describe and demonstrate the installation and layout of lighting outlets.
  - 2.L.01.07 Describe how wiring devices are selected and installed.

- 2L.01 Performance Examples:
- Student will identify and define industry terminology for lighting.
  - Student will select and install lamps into lighting fixtures (luminaries).
  - Student will recognize and install various types of lighting fixtures (luminaries).
  - Student will select the appropriate lighting fixtures for given lighting applications using manufactures' lighting fixture catalogs.

**2.M Basic low voltage wiring.**

- 2.M.01 Explain and apply operating principles of fire and security alarm systems.
- 2.M.01.01 Identify the components of fire and security alarm systems.
- 2.M.01.02 Identify and install Class 1, 2, and 3 low voltage systems.
- 2.M.01.03 Prepare, install, and terminate low voltage cable.

- 2.M.01 Performance Examples:
- Student will identify and install various components of fire and security alarm systems from given project.
  - Student will define the various codes and regulations related to alarm systems (i.e. NFPA 72).

## Strand 3: Embedded Academics

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

### Academic Crosswalks

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

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

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

Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics)

Technology/Engineering

## Strand 4: Employability and Career Readiness

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### 4.A Career Exploration and Navigation

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

- 4.A.03.03 Practice effective interviewing skills: appearance, inquiry and dialogue with interviewer, positive attitude and evidence of work ethic and skills.
- 4.A.03.04 Explore and evaluate employment benefit packages including wages, vacation, health care, union dues, cafeteria plans, tuition reimbursement, retirement and 401K.

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.

#### **4.B Communication in the Workplace**

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

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

#### **4.C Work Ethic and Professionalism**

- 4.C.01 Demonstrate attendance and punctuality.
- 4.C.01.01 Identify and practice professional time-management and attendance behaviors including punctuality, reliability, planning and flexibility.
- 4.C.02 Demonstrate proper workplace appearance.
- 4.C.02.01 Identify and practice professional appearance specific to the workplace.
- 4.C.02.02 Identify and practice personal hygiene appropriate for duties specific to the workplace.
- 4.C.02.03 Identify and wear required safety gear specific to the workplace.
- 4.C.03 Accepts direction and constructive criticism.
- 4.C.03.01 Demonstrate ability (both verbally and non-verbally) to accept direction and constructive criticism and to implement solutions to change behaviors.
- 4.C.03.02 Ask appropriate questions to clarify understanding of feedback.
- 4.C.03.03 Analyze own learning style and seek instructions in a preferred format that works best for their understanding (such as oral, written or visual instruction).
- 4.C.04 Demonstrate motivation and initiative.
- 4.C.04.01 Evaluate assigned tasks for time to completion and prioritization.
- 4.C.04.02 Demonstrate motivation through enthusiasm, engagement, accurate completion of tasks and activities.
- 4.C.04.03 Demonstrate initiative by requesting new assignments and challenges.
- 4.C.04.04 Explain proposed solutions to challenges observed in the workplace.
- 4.C.04.05 Demonstrate the ability to evaluate multiple solutions to problems and challenges using critical reasoning and workplace/industry knowledge and select the best solution to the problem.
- 4.C.04.06 Implement solution(s) to challenges and/or problem(s) observed in the workplace.
- 4.C.04.07 See projects through completion and check work for quality and accuracy.
- 4.C.05 Demonstrate awareness of workplace culture and policy.

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

4. C Performance Examples:

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

### Student Organizations

Business Professionals of America

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

### *Selected Websites*

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



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

## Strand 5: Management and Entrepreneurship Knowledge and Skills

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### 5.A Starting a Business

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

#### 5. A Performance Examples:

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

### 5.B Managing a Business

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

#### 5. B Performance Examples:

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

### 5.C Marketing a Business

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

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

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

## **5.D Financial Concepts and Applications in Business**

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

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

## **5.E Legal/Ethical/Social Responsibilities**

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

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

### *Selected Websites*

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

### *Glossary*

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

**Term**

Chain of Command and Organizational Structure

**Definition**

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

FICA

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

Income Statement

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

Market Research

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

Marketing Mix

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

Methods to Track Inventory, Productivity and Labor Cost

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

Promotional Tools and Techniques

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

Supply Chain

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

Target Market

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

## Strand 6: Technology Literacy Knowledge and Skills

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

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

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

## Appendices

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

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



## Embedded Academic Crosswalks

### Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
2.B.01.06	WHST.6-12.5-8 Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
Performance Example: <ul style="list-style-type: none"> <li>Student will work with assigned partner to identify, develop and complete material quantity takeoff sheets from designated project using electronic resources – all resources must be validated.</li> </ul>		
2.B.01.07	RI.6.3 Reading Standards for Informational Text	Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text.
Performance Example: <ul style="list-style-type: none"> <li>Student will elaborate on how state and/or local code requirements apply to given mechanical print/drawing.</li> </ul>		
2.F.01	SL.9-12.1-3 Speaking and Listening Standards	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.
Performance Example: <ul style="list-style-type: none"> <li>Student will present to the class the purpose and history of the National Electrical Code (NEC) and the Massachusetts Electrical Code (MEC) amendments.</li> </ul>		

### Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.J.01.01	7.G.2 Geometry/ Draw, construct, and describe geometrical figures and describe the relationships between them.	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. (MA 2011 specifies constructing triangles given measures of angles.)

<p>Performance Example:</p> <ul style="list-style-type: none"> <li>Student will design and draw electrical schematics using different geometric shapes</li> </ul>		
2.I.01.03	<p>8.EE.7 Expressions and Equations/ Analyze and solve linear equations and pairs of simultaneous linear equations.</p> <p>8.EE.7a Expressions and Equations/ Analyze and solve linear equations and pairs of simultaneous linear equations.</p> <p>8.EE.7b Expressions and Equations/ Analyze and solve linear equations and pairs of simultaneous linear equations.</p> <p>7.RP.2 Ratios and Proportional Relationships/ Analyze proportional relationships and use them to solve real-world and mathematical problems.</p>	<p>8.EE.7 - Solve linear equations in one variable.</p> <p>8.EE.7a - Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form <math>x = a</math>, <math>a = a</math>, or <math>a = b</math> results (where <math>a</math> and <math>b</math> are different numbers).</p> <p>8.EE.7b - Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>7.RP.2 - Recognize and represent proportional relationships between quantities.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>Student will solve linear equation to identify missing dimension on the installation of the power distribution of electricity project.</li> </ul>		
2.F.03.06	<p>6.NS.6 The Number System/ Apply and extend previous understandings of numbers to the system of rational numbers.</p> <p>6.NS.6c The Number System/ Apply and extend previous understandings of numbers to the system of rational numbers.</p>	<p>6.NS.6 - Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.</p> <p>6.NS.6c - Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>Student will calculate a branch circuit using tables charts from the Massachusetts Electrical Code (MEC).</li> </ul>		
2.G.02.03	<p>9-12.G.CO.9 Geometry/ Congruence Prove geometric theorems</p> <p>9-12.G.C.2 Geometry/Circles Understand and apply theorems about circles</p>	<p>9-12.G.CO.9 - Prove theorems about lines and angles. <i>Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.</i></p> <p>9-12.G.C.2 - Identify and describe relationships among inscribed angles, radii, and chords. <i>Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</i></p> <p>7.G.5 - Use facts about supplementary, complementary, vertical, and</p>

	7.G.5 Geometry/Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	adjacent angles in a multi-step problem to write and use them to solve simple equations for an unknown angle in a figure.
<b>Performance Example:</b> <ul style="list-style-type: none"> <li>Student will install electrical boxes in a vertical position in relationship to a horizontal mark by measuring to a right angle.</li> </ul>		
2.D.02.02	9-12.A.SSE.1 Seeing Structure in Algebra/Expressions Interpret the structure of expressions.  9-12.A.CED.4 Algebra/Creating/Equations Create equations that describe numbers or relationships.	9-12.A.SSE.1 - Interpret expressions that represent a quantity in terms of its context.* □  9-12.A.CED.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. <i>For example, rearrange Ohm's law <math>V = IR</math> to highlight resistance <math>R</math>.</i> *
<b>Performance Example:</b> <ul style="list-style-type: none"> <li>Student will define concepts and calculate values relating to Ohm's law, Watts law and how they pertain to volts, amperes, ohms, impedances, and watts.</li> </ul>		
2.D.01.01	9-12.A.REI.6 Algebra/Reasoning with Equations and Inequalities/ Solve systems of equations  8.EE.8a Expressions and Equations/ Analyze and solve linear equations and pairs of simultaneous linear equations.	9-12.A.REI.6 - Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.  8.EE.8a - Analyze and solve pairs of simultaneous linear equations.
<b>Performance Example:</b> <ul style="list-style-type: none"> <li>Student will solve where an alternating voltage sine wave peaks by using a drawn graph.</li> </ul>		
2.L.01.06	9-12.G.MG.1 Geometry/Modeling with Geometry Apply geometric concepts in modeling situations  9-12.G.C.2 Geometry/Circles Understand and apply theorems about circles  9-12.G.CO.9 Geometry/ Congruence Prove geometric theorems	9-12.G.MG.1- Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*  9-12.G.C.2 - Identify and describe relationships among inscribed angles, radii, and chords. <i>Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</i> 9-12.G.CO.9 - Prove theorems about lines and angles. <i>Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.</i>
<b>Performance Example:</b> <ul style="list-style-type: none"> <li>Student will use round wooden/cardboard templates to layout cut out for the installations of light fixtures.</li> </ul>		

## Embedded Science and Technology/Engineering

### *Physical Science (Physics)*

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.E.01.01	Electromagnetism 5.2	5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		
<ul style="list-style-type: none"> <li>Students will demonstrate their ability to perform measurements of amperage by using a multi-meter.</li> </ul>		
2.E.01.02	Electromagnetism 5.2	5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		
<ul style="list-style-type: none"> <li>Students will demonstrate their ability to perform measurements of voltage by using a multi-meter.</li> </ul>		
2.E.01.03	Electromagnetism 5.2	5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		
<ul style="list-style-type: none"> <li>Students will demonstrate their ability to perform measurements of resistance by using a multi-meter.</li> </ul>		
2.E.01.04	Electromagnetism 5.2	5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		
<ul style="list-style-type: none"> <li>Student will demonstrate knowledge of the operation of a circuit tracer by apply electrical principles through given electrical projects.</li> </ul>		
2.I.01.03	Electromagnetism 5.2	5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example:		
<ul style="list-style-type: none"> <li>Student will calculate and size a service-entrance equipment.</li> </ul>		

### *Technology/Engineering*

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Technology/Engineering Learning Standard
2.A.01.01	Engineering Design 1.5	1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models.
Performance Example:		
<ul style="list-style-type: none"> <li>Students will present plans and explain to the class how to interpret the plans.</li> </ul>		
2.B.02.01	Materials, Tools, and Machines 2.5	2.5 Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example:		
<ul style="list-style-type: none"> <li>Students will complete a safety written and performance exam prior to uses of tools.</li> </ul>		
2.B.02.02	Materials, Tools, and Machines 2.5	2.5 Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example:		
<ul style="list-style-type: none"> <li>Student will demonstrate how to safely use and maintain all power and hand tools designated by instructor.</li> </ul>		

2.C.01.01	Electrical Systems 5.1, 5.2, and 5.3	<p>5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.</p> <p>5.2 Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.</p> <p>5.3 Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>• Student will discuss with the class the differences between conductors and insulators.</li> </ul>		
2.C.01.02	Electrical Systems 5.1, 5.2, and 5.3	<p>5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.</p> <p>5.2 Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.</p> <p>5.3 Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.</p>
<p>Performance Example:</p> <ul style="list-style-type: none"> <li>• Students will demonstrate their ability to quantitatively determine power, voltage, current, and resistance.</li> </ul>		

## DESE Statewide Articulation Agreements

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No Statewide Articulation Agreements at this time.

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

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### Occupational Safety and Health Administration (OSHA) 10 Hour Card - Construction

Hours credit toward Massachusetts Class B (Journeyman) license requirements.

Students may receive up to 300 hours in related theory class towards the required 600 hours and may count all shop and co-op hours towards the required 8000 hours of work experience.

## Other

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### Reference Materials

- NFPA 70®: National Electrical Code® (NEC®) 2011 Edition
- Delmar's Standard Textbook of Electricity Second Edition Stephen L. Herman Delmar Publishers ISBN 0-8273-8550-1 Copyright 1999
- 2011 National Electrical Code with Mass Amendments National Fire Prevention Association NFPA 70 Copyright 2011

### Related National, Regional, and State Professional Organizations

- Local 103 International Brotherhood of Electrical Workers (IBEW)

### Student Organizations

- Skills USA [www.maskillsusa.org](http://www.maskillsusa.org)

### Selected Websites

- <http://www.nfpa.org> National fire prevention
- <http://www.mass.gov/ocabr/licensee/dpl-boards/el/> Mass board of examiners of electricians  
<http://www.lawlib.state.ma.us/source/mass/cmr/cmrtext/527CMR12.pdf> Massachusetts electrical code amendments
- <http://www.necanet.org> National electrical contractors association
- <http://www.iaei.org> International association of electrical inspectors
- <http://www.mecanews.com> Massachusetts Electrical Contractors Association  
<http://www.mass.gov/ocabr/licensee/dpl-boards/el/regulations/rules-and-regs/> Massachusetts laws pertaining to electricians
- <http://www.mass.gov/ocabr/licensee/dpl-boards/el/regulations/rules-and-regs/237-cmr-1300.html#13.01> Initial licensing requirements for Massachusetts