



Vocational Technical Education Framework



Transportation Occupational Cluster

Power Equipment Technology (VPOWEQ)

CIP Code 470606

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Massachusetts Department of Elementary and Secondary Education

Office for Career/Vocational Technical Education

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Commissioner's Letter



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Mitchell D. Chester, Ed.D.
Commissioner

July 2014

Dear Colleagues,

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

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

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

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

Sincerely,

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

Introduction

Overview & Organization and Key Changes

Overview

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

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

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

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

The Office for Career/Vocational Technical Education solicited statewide input from technical and academic teachers and administrators at the annual Massachusetts Association of Vocational Administrators (MAVA)/Massachusetts Vocational Association (MVA) - Connecting for Success Conference. Each framework team met with their content colleagues and reviewed the draft revisions and obtained

valuable feedback. Additionally, all drafts were reviewed and revised by the Massachusetts Vocational Technical Teacher Testing Program, to ensure appropriate measurable language.

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

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

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

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

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

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

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

The Strand Four Team revised the Employability Knowledge and Skills that all students need to acquire. Teams considered current research on career readiness, including the work of the College Career Readiness Task Force convened by the Department, changes in workplace, technological changes that impact how people perform their work (i.e., communications methods), and included standards that emphasize the need for lifelong learning and adaptability given the multiple career changes over and an individual's working life. The team recommended this strand be renamed to: Career Readiness.

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

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

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

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

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

Organization and Key Changes

This section contains the following:

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

Highlights of Changes to the Vocational Technical Education Frameworks:

Strand One:

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

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

Strand Two:

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

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

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

Strand Three:

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

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

Strand Four:

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

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

Strand Five:

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

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

Strand Six

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

Appendix¹

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

The Appendix² contains:

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

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

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Organization of the Frameworks – Strand Two

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

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

2.A Automotive Technology Specific Safety Practices

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

2.A.01 Performance Example:

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

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

2.A.02 Performance Example:

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

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

2.A.03 Performance Example:

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

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

(Topics 2.A through 2.I). These standards are followed by the three concentrations: Arboriculture (Topics 2.J through 2.L), Greenhouse Management and Floriculture (Topics 2.J. through 2.L) and Landscape and Turf Management (Topics 2.M through 2.Q).

Advanced / Supplemental Standards (Not Required)

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

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

Advanced Automotive Technology Technical Knowledge and Skills

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

2.CC Demonstrate appropriate engine repair techniques.

2.CC.01 Perform appropriate cylinder Head Repair.

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

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

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

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

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

2.B.04 Performance Examples:

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

Transportation Occupational Cluster

Power Equipment Technology Framework (VPOWEQ)

Strand 1: Safety and Health Knowledge and Skills

1.A Fundamentals of Health and Safety

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

1. A.01 Performance Examples:

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

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

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

1. A.02 Performance Examples:

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

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

1. A.03 Performance Example:

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

Selected Websites

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

Strand 2: Technical Knowledge and Skills

2.A Fundamentals of Work Area Safety

- 2.A.01 Demonstrate safety precautions in the operation and service of power equipment according to current industry and OSHA standards.
- 2.A.01.01 Identify safety checklists and procedures used while servicing and operating equipment.
 - 2.A.01.02 Identify and describe occupational safety precautions and procedures in fire safety and other emergency situations per Occupational Safety and Health Administration (OSHA) standards.
 - 2.A.01.03 Identify and demonstrate handling of chemicals and fuels that are commonly used in the servicing of power equipment.
 - 2.A.01.04 Demonstrate the use of Personal Protective Equipment (PPE).
 - 2.A.01.05 Identify and demonstrate safety procedures of lift equipment.
 - 2.A.01.06 Demonstrate use and storage of hydraulic floor jacks and safety stands.
 - 2.A.01.07 Explain hazards associated with the handling of batteries and follow electrical precautions.

2. A.01 Performance Examples:

- Students will demonstrate safe practices while servicing equipment.
- Students will demonstrate safe practices while handling batteries.

2.B Fundamentals of Tools and Special Equipment

- 2.B.01 Select and use appropriate tools and equipment to perform a given task.
- 2.B.01.01 Identify basic hand tools.
 - 2.B.01.02 Demonstrate set-up/adjustment, maintenance, and storage of all basic hand tools.
 - 2.B.01.03 Identify basic power tools.
 - 2.B.01.04 Demonstrate set-up/adjustment, maintenance, and storage of all basic power tools.
 - 2.B.01.05 Demonstrate use and maintenance of grinding equipment.
 - 2.B.01.06 Demonstrate use and maintenance of soldering tools.
 - 2.B.01.07 Demonstrate use and maintenance of air impact tools.
 - 2.B.01.08 Demonstrate use and maintenance of tire changing equipment.
 - 2.B.01.09 Demonstrate use and maintenance of a hydraulic press or puller.
 - 2.B.01.10 Use and maintain a torque wrench.

2.B.01 Performance Examples:

- Student will identify and demonstrate the use of different sized screwdrivers.
- Student will identify and demonstrate the use of the different types of air impact equipment.

- 2.B.02 Select and use appropriate measurement tools to perform a given task according to current industry and OSHA standards.
- 2.B.02.01 Identify commonly used basic measuring tools.
 - 2.B.02.02 Demonstrate use of basic measuring tools.
 - 2.B.02.03 Identify precision measurement tools.
 - 2.B.02.04 Demonstrate use of precision tools.

- 2.B.02 Performance Examples:
- Student will demonstrate the use of a combination square.
 - Student will demonstrate the use and maintenance of a micrometer.

- 2.B.03 Select and use appropriate specialty tools and diagnostic/testing equipment according to current industry and OSHA standards.
- 2.B.03.01 Identify specialty tools to service and repair Outdoor Power Equipment (OPE).
- 2.B.03.02 Demonstrate maintenance and usage of all specialty tools.
- 2.B.03.03 Identify diagnostic/testing equipment.
- 2.B.03.04 Demonstrate maintenance and usage of all diagnostic/testing equipment.

- 2.B.03 Performance Examples:
- Student will demonstrate the use of an oil filter wrench.
 - Student will demonstrate the use of a cylinder compression tester.

- 2.B.04 Select and use diagnostics and troubleshooting techniques according to current industry and OSHA standards.
- 2.B.04.01 Describe the principles of diagnostics and troubleshooting.
- 2.B.04.02 Identify systems, their components and the sequence of events in a system.
- 2.B.04.03 Remove, test and replace ignition armature module.
- 2.B.04.04 Test capacitive discharge ignition system.
- 2.B.04.05 Inspect ignition system and a perform three-point spark test.
- 2.B.04.06 Demonstrate timing procedure.
- 2.B.04.07 Measure primary and secondary resistance.
- 2.B.04.08 Check safety interlock devices for proper operation; correct all problems and provide written documentation of repairs.
- 2.B.04.09 Analyze and identify engine failures and document results.
- 2.B.04.10 Inspect and test fuel system using pressure test.
- 2.B.04.11 Inspect, bench and pressure test the carburetor.
- 2.B.04.12 Inspect and perform fuel pump pressure test.
- 2.B.04.13 Inspect and test exhaust system for restriction or leakage.
- 2.B.04.14 Perform cylinder balance test and record results.
- 2.B.04.15 Perform cylinder compression test and record results.
- 2.B.04.16 Perform cylinder leak down test and record results.
- 2.B.04.17 Inspect crankcase integrity with pressure/vacuum pump.
- 2.B.04.18 Operate the engine to analyze starting, acceleration and power output under load.

- 2.B.04 Performance Examples:
- Student will be able to remove test and replace an ignition armature module.
 - Student will identify a carburetor and its components.
 - Student will perform a cylinder leak down test.
 - Student will demonstrate the proper use of an oil filter wrench.

- 2.B.05 Select and operate lifting equipment according to current industry and OSHA standards.
- 2.B.05.01 Identify various types of lifting and hoisting equipment.
- 2.B.05.02 Demonstrate usage of lifting and hoisting equipment according to current industry and OSHA standards and state laws/regulations.

- 2.B.05 Performance Examples:
- Student will identify a chain fall.
 - Student will demonstrate the usage of a hydraulic lift.

- 2.B.06 Select and demonstrate use of cleaning equipment according to current industry and OSHA standards.
- 2.B.06.01 Identify basic cleaning equipment.
 - 2.B.06.02 Demonstrate usage of cleaning equipment such as a solvent tank, pressure washer and steam cleaner.
 - 2.B.06.03 Demonstrate disposal of cleaning materials based on the Environmental Protection Agency (EPA) and local regulations.

- 2.B.06 Performance Examples:
- Student will demonstrate handling of used anti-freeze.
 - Student will demonstrate usage of a pressure washer.

2.C Information/Communications

- 2.C.01 Demonstrate customer service according to current industry standards.
- 2.C.01.01 Interview the customer/operator and record comments and information on the work-order.
 - 2.C.01.02 Complete a thorough visual and physical examination; determine and classify all symptoms of a problem.
 - 2.C.01.03 Record the results of all testing on the work-order.
 - 2.C.01.04 Make all necessary repairs and retest to verify the repair is complete.
 - 2.C.01.05 Demonstrate customer service practices to communicate with the customer regarding the cause of the repair and prevention of future problems.
 - 2.C.01.06 Complete and interpret pre-delivery and delivery instructions.

- 2.C.01 Performance Examples:
- Student will demonstrate proper techniques to interview a customer.
 - Student will properly record data on a work-order.
 - Student will complete a pre-delivery check list.

- 2.C.02 Demonstrate the use of technical data and records maintenance according to current industry standards.
- 2.C.02.01 Identify manufacturer, model and serial number of engine.
 - 2.C.02.02 Identify manufacturer, model and serial number of equipment (not engine).
 - 2.C.02.03 Demonstrate the use of service and parts manual formats, such as paper, CD, DVD, web based and microfiche, to locate service, torque specifications, and procedures.
 - 2.C.02.04 Document service and/or repair work on a work-order.
 - 2.C.02.05 Document parts and shop supplies used on a work-order and shop inventory list.
 - 2.C.02.06 Complete various original equipment manufacturer (OEM) warranty forms.
 - 2.C.02.07 Identify, interpret and demonstrate recommended service operations and maintenance schedules from an operator's manual.

- 2.C.02 Performance Examples:
- Student will demonstrate the use of a service manual.
 - Student will demonstrate the ability to locate parts using various methods.

- 2.C.03 Demonstrate industry expected workmanship according to current industry and OSHA standards.
 - 2.C.03.01 Demonstrate and maintain a neat and organized workspace.
 - 2.C.03.02 Demonstrate use of bins, paperwork and digital recordings of parts for projects.
 - 2.C.03.03 Perform tasks in a timely manner without sacrificing quality.

- 2.C.03 Performance Examples:
- Student will maintain an organized workspace.
 - Student will operate a digital camera to record projects.

2.D Fundamentals of Industry Practices on Outdoor Power Equipment (OPE)

- 2.D.01 Identify and demonstrate use of industry fasteners.
 - 2.D.01.01 Identify fasteners used on small gas engines and OPE implements.
 - 2.D.01.02 Remove and install various fasteners and gaskets.
 - 2.D.01.03 Repair or produce internal and external threads.

- 2.D.01 Performance Examples:
- Student will identify metric bolts.
 - Students will differentiate between types of washers.
 - Student will demonstrate the proper repair of damaged threads.

- 2.D.02 Identify and demonstrate the use of industry equipment and OPE according to current industry and OSHA standards.
 - 2.D.02.01 Identify safe tractor, machinery and equipment operation practices for consumer and commercial uses.
 - 2.D.02.01 Identify unsafe/dangerous conditions of equipment (e.g., cracked deck, split belt, etc.).
 - 2.D.02.02 Demonstrate methods of starting, stopping and operating outdoor power equipment (OPE).
 - 2.D.02.03 Select fuels, coolants, lubricants and hydraulic fluids for tractors, machinery and equipment.
 - 2.D.02.04 Identify the parts and functions of electrical, hydraulic, lubrication, cooling, exhaust, fuel, governor, induction and drive systems.
 - 2.D.02.05 Conduct a pre-operation inspection of a tractor and/or equipment.
 - 2.D.02.06 Establish ballast and tire pressure.
 - 2.D.02.07 Demonstrate mower deck service and blade sharpening techniques.
 - 2.D.02.08 Demonstrate saw sharpening techniques.
 - 2.D.02.09 Demonstrate service and maintenance of chainsaws and handheld equipment.
 - 2.D.02.10 Explain American National Standards Institute (ANSI) standards such as: kick back, operator presence etc.
 - 2.D.02.11 Adjust steering linkage, including tow-in.
 - 2.D.02.12 Inspect and adjust drive line components.
 - 2.D.02.13 Install, adjust and service belt and chain drives.
 - 2.D.02.14 Prepare tractor, machinery or equipment for storage.

- 2.D.02 Performance Examples:
- Student will demonstrate the safe starting of a chainsaw.
 - Student will select proper fuel for a lawn mower.
 - Student will explain ANSI standards of kick-back.

- 2.D.03 Describe and demonstrate service and repair of drive trains and associated systems according to current industry and OSHA standards.
- 2.D.03.01 Service and/or repair various drive systems.
 - 2.D.03.02 Service and/or repair various clutches.
 - 2.D.03.03 Service manual and hydrostatic transmissions.

- 2.D.03 Performance Examples:
- Student will identify a drive system.
 - Student will demonstrate the service of a hydrostatic transmission.

- 2.D.04 Diagnose and repair generator malfunctions in power equipment.
- 2.D.04.01 Identify components of generators.
 - 2.D.04.02 Explain and demonstrate the repair of generator malfunctions in power equipment.
 - 2.D.04.03 Explain the operation of brush/slip-ring vs. brushless (induction) type generators.
 - 2.D.04.04 Diagnose and repair generator output problems.

- 2.D.04 Performance Example:
- Student will explain the operation of a brushless type generator.

2.E Fundamentals of Service and Repair of Engines

- 2.E.01 Identify and explain two and four stroke cycle engines.
- 2.E.01.01 Explain two stroke cycle engine operation and theory.
 - 2.E.01.02 Explain the differences between piston ported, reed and rotary valve operations.
 - 2.E.01.03 Explain four stroke cycle engine operation and theory.
 - 2.E.01.04 Identify four stroke cycle engine components, parts and describe their purpose.

- 2.E.01 Performance Examples:
- Student will explain two stroke cycle engine operation.
 - Student will explain four stroke cycle engine operation.

- 2.E.02 Identify and describe components of diesel engines.
- 2.E.02.01 Explain diesel two and four stroke cycle engine operation and theory.
 - 2.E.02.02 Describe turbo charging vs. normal aspiration.
 - 2.E.02.03 Describe super charging vs. normal aspiration.
 - 2.E.02.04 Identify and select lubricants specified for diesel engine use.
 - 2.E.02.05 Diagnose common diesel operating issues.

- 2.E.02 Performance Examples:
- Student will describe turbo charging.
 - Student will select proper lubricants for a diesel engine.

- 2.E.03 Explain fundamentals of lubrication according to current industry and OSHA standards.
- 2.E.03.01 Describe the theory of lubrication.
 - 2.E.03.02 Describe the American Petroleum Institute (API) oil ratings and the Society of Automotive Engineers (SAE) viscosity ratings.
 - 2.E.03.03 Describe the classification of two stroke engines and mix a given oil ratio for two cycle engine.
 - 2.E.03.04 Describe the functions of engine oil.
 - 2.E.03.05 Describe splash vs. pressure lubrication systems.
 - 2.E.03.06 Describe the two types of oil filtration systems.
 - 2.E.03.07 Demonstrate methods of checking oil level in an engine.
 - 2.E.03.08 Change engine oil and filter on a variety of equipment.

- 2.E.03 Performance Examples:
- Student will explain SAE viscosity ratings.
 - Student will differentiate between oil ratings.

- 2.E.04 Service cooling systems according to current industry and OSHA standards.
- 2.E.04.01 Describe the major types of cooling systems used on power equipment and explain their purpose.
 - 2.E.04.02 Identify and repair the major causes of air-cooled engine overheating.
 - 2.E.04.03 Perform cooling system flush and cleaning of a liquid cooled engine.
 - 2.E.04.04 Inspect, remove and replace a water pump.
 - 2.E.04.05 Inspect, remove and replace a thermostat.

- 2.E.04 Performance Examples:
- Student will differentiate cooling systems.
 - Student will flush a cooling system.

- 2.E.05 Service fuel systems according to current industry and OSHA standards.
- 2.E.05.01 Define the types and grades of fuels used in power equipment.
 - 2.E.05.02 Describe the use of a fuel additive for storage.
 - 2.E.05.03 Describe and perform the method of carburetor cleaning.
 - 2.E.05.04 Describe potential problems for oil/fuel mixtures.
 - 2.E.05.05 Identify common types and nomenclature of fuel pumps.
 - 2.E.05.06 Define accelerator pump nomenclature and function.
 - 2.E.05.07 Explain the theory and function of fuel injection.
 - 2.E.05.08 Inspect, remove and replace a carburetor on a small gasoline engine.
 - 2.E.05.09 Clean and install a repair kit in a carburetor.
 - 2.E.05.10 Inspect internal carburetor parts for wear.
 - 2.E.05.11 Inspect, remove and replace the fuel tank, filters, caps, hoses and lines.
 - 2.E.05.12 Adjust carburetor linkage.
 - 2.E.05.13 Adjust carburetor mixture screws per OEM specifications.
 - 2.E.05.14 Set and adjust carburetor float.

- 2.E.05 Performance Examples:
- Student will identify grades of fuels.
 - Student will explain the function of fuel injection.
 - Student will adjust the fuel mixture in a carburetor.

- 2.E.06 Service exhaust systems and its components according to current industry and OSHA standards.
- 2.E.06.01 Define and describe an air filter system nomenclature and explain its function.
 - 2.E.06.02 Demonstrate normal service procedures performed on each type of air filter system.
 - 2.E.06.03 Identify exhaust system types, nomenclature and describe their functions.
 - 2.E.06.04 Describe proper service cleaning procedures for exhaust ports and spark arrestor screens.

- 2.E.06 Performance Examples:
- Student will identify a muffler and explain its function.
 - Student will identify and clean a spark arrestor.

- 2.E.07 Service ignition, starting and electrical systems according to current industry and OSHA standards.
- 2.E.07.01 Explain electrical/electronic terms that are common to the power equipment industry.
 - 2.E.07.02 Describe the purpose of an ignition system.
 - 2.E.07.03 Define engine starting systems nomenclature and function.
 - 2.E.07.04 Identify the components and function of a battery ignition system.
 - 2.E.07.05 Identify the components and function of a magneto ignition system.
 - 2.E.07.06 Identify the components and function of a recoil starting system.
 - 2.E.07.07 Test, remove and replace a starter motor.
 - 2.E.07.08 Test, remove and replace a starter relay (solenoid).
 - 2.E.07.09 Service three different styles of rewind starters.
 - 2.E.07.10 Replace a starter drive gear.
 - 2.E.07.11 Disassemble and reassemble a 12 volt DC-120 volt AC starter motor.
 - 2.E.07.12 Define charging system nomenclature and describe their functions.
 - 2.E.07.13 Describe and demonstrate an AC/DC volt test.
 - 2.E.07.14 Describe the function of diodes and rectifiers.
 - 2.E.07.15 Perform current drain and charging test using a DC shunt.
 - 2.E.07.16 Remove and replace a regulator/rectifier.
 - 2.E.07.17 Describe series and parallel circuits.
 - 2.E.07.18 Explain different types of circuit failures.
 - 2.E.07.19 Check continuity in circuits and electrical system components.
 - 2.E.07.20 Check current flow in electrical systems and components.
 - 2.E.07.21 Inspect, test and replace fusible links, fuses and circuit breakers.
 - 2.E.07.22 Identify and install terminals and connectors used in electrical systems.
 - 2.E.07.23 Calculate electrical wire sizes and selection based on anticipated current load.
 - 2.E.07.24 Identify sending units used in an electrical circuit and explain their function.
 - 2.E.07.25 Explain storage battery theory and operation.
 - 2.E.07.26 Clean, test, remove and replace a battery.

- 2.E.07 Performance Examples:
- Student will describe the purpose of an ignition system.
 - Student will remove a starter motor.

- 2.E.08 Service governor systems.
 - 2.E.08.01 Identify the purpose of a governor system.
 - 2.E.08.02 Describe governor system nomenclature and function.
 - 2.E.08.03 Adjust pneumatic and mechanical governor system settings.

- 2.E.08 Performance Examples:
- Student will describe the purpose of a governor.
 - Student will adjust a governor system setting.

- 2.E.09 Inspect, remove, rebuild and install engines.
 - 2.E.09.01 Inspect valve and seats, resurface or replace.
 - 2.E.09.02 Demonstrate and explain valve lapping operation.
 - 2.E.09.03 Remove ridge, de-glaze and clean cylinder bore using a rigid hone.
 - 2.E.09.04 Explain OEM cylinder reuse specification.
 - 2.E.09.05 Inspect and measure camshaft bearings for wear and damage.
 - 2.E.09.06 Inspect valve train including, valves, seats, valve guides, rocker arms, lifters, studs, and push rods.
 - 2.E.09.07 Inspect balance system.
 - 2.E.09.08 Inspect shafts and support bearings for damage and wear.
 - 2.E.09.09 Measure and determine values for engine bearings.
 - 2.E.09.10 Use a plasti-gauge to determine bearing clearances in an engine.
 - 2.E.09.11 Install all engine components, assemblies and gaskets; torque according to manufacturer's specifications and procedures.
 - 2.E.09.12 Install the crankshaft with its bearings.
 - 2.E.09.13 Measure crankshaft end play.
 - 2.E.09.14 Measure crankshaft run-out.
 - 2.E.09.15 Verify camshaft timing according to manufacturer's specifications and procedure.
 - 2.E.09.16 Adjust values (mechanical and hydraulic).
 - 2.E.09.17 Assemble and test run engine.

- 2.E.09 Performance Examples:
- Student will resurface a valve.
 - Student will measure crankshaft run-out.
 - Student will determine bearing clearance.

Advanced Technical Skills in Power Equipment

Students that wish to excel and broaden their knowledge may apply their Power Equipment skills in the following areas noted below. These technical competencies are not required, rather are supplemental/optional.

2.F Fundamentals of Motorcycles and ATV's

- 2.F.01* Identify and service motorcycles and all-terrain vehicles (ATV's) according to current industry and OSHA standards.
 - 2.F.01.01* Service motorcycles and ATV's.
 - 2.F.01.02* Diagnose and repair common chassis and suspension problems.
 - 2.F.01.03* Examine and diagnose tire issues including repair, mounting and balancing.

- 2.F.01.04* Differentiate between and service mechanical and hydraulic braking systems.

- 2.F.01* Advanced Performance Examples:
- Student will mount and balance a tire.
 - Student will repair leaking fork seals.

2.G Fundamentals of Marine Equipment

- 2.G.01* Diagnose and service Marine equipment according to current industry and OSHA standards.
- 2.G.01.01* Service marine equipment.
- 2.G.01.02* Diagnose and service an outboard drive assembly.
- 2.G.01.03* Diagnose and service a stern-drive assembly.
- 2.G.01.04* Assess and demonstrate propeller pitch and size for a given vessel.
- 2.G.01.05* Demonstrate servicing of a personal water craft (PWC) according to the manufacturer's specifications.

- 2.G.01* Advanced Performance Examples:
- Student will change the lower end lube of a given out-drive.
 - Student will set the proper pitch of a propeller.

2.H Fundamentals of Horse Power and Torque

- 2.H.01* Measure and calculate horse power and torque.
- 2.H.01.01* Explain and measure horsepower.
- 2.H.01.02* Measure torque and revolutions per minute (RPM) to calculate horsepower.
- 2.H.01.03* Compare values before and after engine alteration using a Dynamometer.

- 2.H.01* Advanced Performance Examples:
- Student will demonstrate use of a dynamometer machine.
 - Student will determine how to measure horsepower.

2.I Fundamentals of Welding

- 2.I.01* Identify and demonstrate welding and cutting techniques according to current industry and OSHA standards.
- 2.I.01.01* Identify and demonstrate safe set-up of gas welding and cutting equipment.
- 2.I.01.02* Identify and demonstrate safe set-up of electric welding equipment.
- 2.I.01.03* Demonstrate safe welding and cutting techniques on given sample metal parts.

- 2.I.01* Advanced Performance Examples:
- Student will demonstrate safe use of a gas welder.
 - Student will perform cutting techniques on a given piece of metal.

Strand 3: Embedded Academics

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

Academic Crosswalks

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

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

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

Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics)

Technology/Engineering

Strand 4: Employability and Career Readiness

4.A Career Exploration and Navigation

- 4.A.01 Develop a career plan and portfolio.
 - 4.A.01.01 Develop and revise career plan annually based on workplace awareness and skill attainment.
 - 4.A.01.02 Assess personal strengths and interest areas to determine potential careers, career pathways and career ladders.
 - 4.A.01.03 Examine potential career field(s)/discipline(s) and identify criteria to select, secure and keep employment in chosen field(s).
 - 4.A.01.04 Research and evaluate a variety of careers utilizing multiple sources of information and resources to determine potential career(s) and alternatives.
 - 4.A.01.05 Identify training and education requirements that lead to employment in chosen field(s) and demonstrate skills related to evaluating employment opportunities.
 - 4.A.01.06 Explore and evaluate postsecondary educational opportunities including degrees and certifications available, traditional and nontraditional postsecondary pathways, technical school and apprenticeships, cost of education, financing methods including scholarships and loans and the cost of loan repayment.
 - 4.A.01.07 Create a portfolio showcasing academic and career growth including a career plan, safety credential, resume and a competency profile demonstrating the acquisition of the knowledge and skills associated with at least two years of full-time study in the Chapter 74 program.

- 4.A.02 Demonstrate job search skills.
 - 4.A.02.01 Conduct a job search and complete written and electronic job applications, resumes, cover letters and related correspondence for a chosen career path.
 - 4.A.02.02 Explore and evaluate postsecondary job opportunities and career pathways specific to career technical areas.
 - 4.A.02.03 Identify role and use of social media and networking for staying current with career and employment trends as well as networking, job seeking and career development opportunities.
 - 4.A.02.04 Demonstrate ability to use social media and networking to develop useful occupational contacts, job seeking and career development opportunities.

- 4.A.03 Demonstrate all phases of the job interview process.
 - 4.A.03.01 Gather relevant information about potential employer(s) from multiple print and digital sources, assessing the credibility and accuracy of each source.
 - 4.A.03.02 Identify employment eligibility criteria, such as drug/alcohol free status, clean driving record, etc.

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

Selected Websites

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

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

Strand 5: Management and Entrepreneurship Knowledge and Skills

5.A Starting a Business

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

5. A Performance Examples:

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

5.B Managing a Business

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

5. B Performance Examples:

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

5.C Marketing a Business

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

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

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

5.D Financial Concepts and Applications in Business

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

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

5.E Legal/Ethical/Social Responsibilities

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

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

Selected Websites

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

Glossary

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

Term

Chain of Command and Organizational Structure

**Definition**

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

FICA

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

Income Statement

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

Market Research

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

Marketing Mix

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

Methods to Track Inventory, Productivity and Labor Cost

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

Promotional Tools and Techniques

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

Supply Chain

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

Target Market

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

Strand 6: Technology Literacy Knowledge and Skills

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

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

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

Appendices

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

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

Embedded Academic Crosswalks

Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
2.B.04.01 2.C.02.07 2.E.05.03 2.E.05.05 2.E.05.06 2.E.05.07 2.E.06.01 2.E.07.17 2.E.07.25 2.B.04.02 2.C.02.07	RST1 Grades 9-10 and Grades 11-12 RST3 Grades 9-10 and Grades 11-12	Cite specific textural evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations.
<p>Performance Example:</p> <ul style="list-style-type: none"> ▪ Students will troubleshoot a technical problem using proper diagnostic principles. They will also be able to identify the system where the trouble is located, and explain the proper sequence of events in the system. 		
2.C.01.01 2.C.01.05 2.C.01.06	SL1 Grades 9-10 and Grades 11-12	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 other's ideas and expressing their own clearly and persuasively.
<p>Performance Example:</p> <ul style="list-style-type: none"> ▪ Students will fill out a work order after/while interviewing a customer. They will show proper customer service practices to communicate effectively regarding repair, causes, prevention, and pre and post-delivery instructions. 		
2.C.04.01	RST5 Grades 9-10 and Grades 11-12	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
<p>Performance Example:</p> <ul style="list-style-type: none"> ▪ Students will explain the operation of generators; comparing the brush/slip-ring versus the brushless (induction) type. 		
2.E.05.01 2.E.05.03 2.E.5.05 2.E.05.06 2.E.05.07 2.E.06.01 2.E.07.17 2.E.07.25	RST4 Grades 9-10 and Grades 11-12	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to texts and topics.
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Students will define, describe, identify, and explain the use for different grades of fuels. ▪ Student will identify a muffler and explain its function. ▪ Student will describe the purpose of an ignition system. 		
2.E.05.01 2.E.05.03 2.E.05.05 2.E.05.06	WHST2 Grades 9-10 and 11-12	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

2.E.05.07 2.E.06.01 2.E.07.17 2.E.07.25		
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will define, describe, identify, and explain several terms and fundamentals of fuel, ignition, electrical, and governor systems. Not only will they use texts to find answers, they will also use a variety of research materials and fully explain one or more of the systems in writing of a technical nature. Students will demonstrate proper methods for carrying out several tasks related to the systems they defined. 		
2.E.05.01 2.E.05.03 2.E.05.05 2.E.05.06 2.E.05.07 2.E.06.01 2.E.07.17 2.E.07.25	W7 Grades 9-10 and Grades 11-12	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
<p>Performance Example:</p> <ul style="list-style-type: none"> Students will use manuals and other forms of media to identify and explain fundamentals of fuel, ignition, electrical, and governor systems. Students will demonstrate proper methods for carrying out several tasks related to the systems they defined. 		

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.B.02.01 2.B.02.02 2.B.02.03 2.B.02.04	G-CO-12 5.MD.1 7.G.1 7.G.2	<p>Make geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic software, etc.).</p> <p>Convert among different-sized standard measurement units within a given measurement system and use these conversions in solving multi-step, real-world problems.</p> <p>Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</p> <p>Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> Student will demonstrate the proper use of a combination square. Student will demonstrate the proper use and maintenance of a micrometer. 		
2.E.09.09 2.E.09.16	5.MD.1 7.RP.1 4.NF.7 4.MD.1 4.MD.2	<p>Convert among different-sized standard measurement units within a given measurement system and use these conversions in solving multi-step, real-world problems.</p> <p>Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.</p> <p>Understand decimal notation for fractions, and compare decimal fractions.</p> <p>Know relative sizes of measurements units within one system of units, including km, m, cm; kg, g; lb, oz; l ml; hr, min, sec. Within a single system of measurements, express measurements in a larger</p>

		<p>unit in terms of a smaller unit.</p> <p>Use the four operations to solve word problems involving simple fractions or decimals and problems that require expressing measurements given in a larger unit in terms of a smaller unit.</p> <p>Represent measurement quantities using diagrams that feature a measurement scale.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will properly measure crankshaft run-out. ▪ Student will determine bearing clearance. 		
<p>2.H.01.01</p> <p>2.H.01.02</p> <p>2.H.01.03</p>	<p>6.RP.1</p> <p>6.RP.3</p> <p>6.RP.3b</p> <p>7.RP.1</p> <p>8.F.4</p> <p>8.G.7</p> <p>8.G.8</p>	<p>Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (Solve unit rate problems involving constant speed.)</p> <p>Compute unit rates associated with ratios of fractions, including ratios of length, areas, and other quantities measured in like or different units.</p> <p>Use functions to model relationships between quantities.</p> <p>Apply the Pythagorean Theorem to determine unknown side lengths in right triangle in real-world and mathematical problems in two and three dimensions.</p> <p>Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will demonstrate proper and safe use of a dynamometer machine. ▪ Student will demonstrate the ability to measure horsepower. 		

Embedded Science and Technology/Engineering

Life Science (Biology)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Biology Learning Standard
2.E.05.01	<p>Energy Resources in the Earth System</p> <p>2.1</p> <p>2.2</p>	<p>Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy).</p> <p>Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will identify grades of fuel. ▪ Student will explain the function of fuel injection. ▪ Student will adjust the fuel mixture in a carburetor. 		

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.B.04.10 2.B.04.15 2.D.02.06	States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.1 6.2	Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's Law), volume and temperature (Charles's Law), pressure and temperature (Gay-Lussac's Law), and the number of particles in a gas sample (Avogadro's hypothesis). Use combined gas law to determine changes in pressure, volume, and temperature. Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).
Performance Examples: <ul style="list-style-type: none"> ▪ Student will be able to remove, test and replace an ignition armature module. ▪ Student will identify a carburetor and its components. ▪ Student will perform a cylinder leak down test. ▪ Student will demonstrate safe starting of a chainsaw. ▪ Student will select proper fuel for lawnmower. ▪ Student will explain ANSI standards of kick-back. 		
2.B.06.03	Acids and Bases Oxidation-Reduction Reactions 8.1 8.2	Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronstad-Lowery theory of acids and bases in terms of proton donors and acceptors. Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice.)
Performance Examples: <ul style="list-style-type: none"> ▪ Student will demonstrate the safe handling of used anti-freeze. ▪ Student will demonstrate safe usage of a pressure washer. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.B.05.01 2.B.05.02	Conservation of Energy and Momentum 2.2 2.3	Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa. Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
Performance Examples: <ul style="list-style-type: none"> ▪ Student will identify a chain fall. ▪ Student will demonstrate the proper and safe usage of a hydraulic lift. 		
2.D.02.13	Conservation of Energy and Momentum 2.3 2.4	Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy. Describe both qualitatively and quantitatively the concept of power as work done per unit time.

Performance Examples: <ul style="list-style-type: none"> ▪ Student will demonstrate safe starting of a chainsaw. ▪ Student will select proper fuel for a lawnmower. ▪ Student will explain ANSI standards of kick-back. 		
2.E.03.01 2.E.03.02	Motion and Forces 1.6	Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects.
Performance Examples: <ul style="list-style-type: none"> ▪ Student will explain SAE viscosity ratings. ▪ Student will differentiate between oil ratings. 		
2.E.07.13	Electromagnetism 5.1	Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
Performance Examples: <ul style="list-style-type: none"> ▪ Student will describe the purpose of an ignition system. ▪ Student will remove a starter motor. 		
2.E.07.17 2.E.07.19	Electromagnetism 5.2 5.3	Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law). Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
Performance Examples: <ul style="list-style-type: none"> ▪ Student will describe the purpose of an ignition system. ▪ Student will remove a starter motor. 		

Scientific Inquiry Skills Standards

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Scientific Inquiry Skills Learning Standard
2.B.04.01	SIS1	Make observations, raise questions, and formulate hypotheses. Observe the world from a scientific perspective. Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge.
Performance Examples: <ul style="list-style-type: none"> ▪ Student will be able to remove test and replace an ignition armature module. ▪ Student will identify a carburetor and its components. ▪ Student will perform a cylinder leak down test. 		
2.B.04.01	SIS2	Design and conduct scientific investigations. Articulate and explain the major concepts being investigated and the purpose of an investigation. Select required materials, equipment, and conditions for conducting an experiment. Identify independent and dependent variables. Write procedures that are clear and replicable. Employ appropriate methods for accurately and consistently making observations making and recording measurements at appropriate levels of precision collecting data or evidence in an organized way Follow safety guidelines.

<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will be able to remove test and replace an ignition armature module. ▪ Student will identify a carburetor and its components. ▪ Student will perform a cylinder leak down test. 		
2.B.04.02	SIS3	<p>Analyze and interpret results of scientific investigations. Present relationships between and among variables in appropriate forms. Represent data and relationships between and among variables in charts and graphs. Use appropriate technology (e.g., graphing software) and other tools. Use mathematical operations to analyze and interpret data results. Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrolled conditions. Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis. State questions raised by an experiment that may require further investigation.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will be able to remove test and replace an ignition armature module. ▪ Student will identify a carburetor and its components. ▪ Student will perform a cylinder leak down test. 		
2.B.04.02	SIS4	<p>Communicate and apply the results of scientific investigations. Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations. Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation. Explain diagrams and charts that represent relationships of variables. Construct a reasoned argument and respond appropriately to critical comments and questions. Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings. Use and refine scientific models that simulate physical processes or phenomena.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> ▪ Student will be able to remove test and replace an ignition armature module. ▪ Student will identify a carburetor and its components. ▪ Student will perform a cylinder leak down test. 		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

- The Equipment and Engine Training Council (EETC) offers certification as Master Technician of Power Equipment in the areas noted below. This certification is currently available for all eligible recipients at Baypath Regional Vocational Technical High School in Charlton, MA:
 - Four Stroke Gasoline Engines
 - Two Stroke Gasoline Engines
 - Electrical
 - Compact Diesel
 - Generator
 - Driveline/Hydro
 - Reel Technology
- Occupational Safety and Health Administration (OSHA) General Certification (10 hour classroom/online program)

Other

Reference Materials

- Equipment and Engine Training Council (EETC) Accreditation Manual
- Power Equipment Engine Technology by Edward Abdo
- Outdoor Power Equipment by Jay Webster
- Small Engines by Radcliff and Roark
- Small Gas Engines by Roth
- Understanding the Outboard Motor by Stagner
- Motorcycles Fundamentals Service and Repair by Johns, Edmundson and Sharff
- Power Equipment Trade Magazine
- www.bls.gov/ooh/installation-maintenance-and-repair/small-engine-mechanics.htm
- <http://www.osha.gov/dte/outreach/generalindustry/index.html>

Related National, Regional, and State Professional Organizations

- Northeast Equipment Dealers Association-Liverpool, NY
- Outdoor Power Equipment and Engine Service Association-Essex, CT
- North American Equipment Dealers Association-Fenton, MO
- Outdoor Power Equipment After Market Association-Alexandria, VA
- Outdoor Power Equipment Industry (OPEI) Alexandria, Virginia

Student Organizations

- Skills USA www.mskillsusa.org

Selected Websites

- Equipment and Engine Training Council - www.eetc.org
- Northeast Equipment Dealers Association - www.ne-equip.com
- www.opees.com
- Power Equipment Trade - www.powerequipmenttrade.com
- North American Equipment Dealers Association - www.naeda.com