



Vocational Technical Education Framework



Transportation Occupational Cluster

Marine Service Technology (VMRNS)

CIP Code 470616

June 2014

Massachusetts Department of Elementary and Secondary Education

Office for Career/Vocational Technical Education

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Table of Contents

Acknowledgements.....	1
Commissioner’s Letter	4
Introduction	5
<i>Transportation Occupational Cluster</i>	14
<i>Marine Service Technology Framework (VMRNS)</i>	14
Strand 1: Safety and Health Knowledge and Skills.....	14
<i>Selected Websites</i>	16
Strand 2: Technical Knowledge and Skills	17
Strand 3: Embedded Academics	24
Strand 4: Employability and Career Readiness	25
<i>Selected Websites</i>	28
Strand 5: Management and Entrepreneurship Knowledge and Skills	30
<i>Selected Websites</i>	32
<i>Glossary</i>	32
Strand 6: Technology Literacy Knowledge and Skills	34
Appendices.....	36
Embedded Academic Crosswalks.....	37
Embedded English Language Arts and Literacy	37
Embedded Mathematics.....	38
Embedded Science and Technology/Engineering.....	39
<i>Life Science (Biology)</i>	39
<i>Physical Science (Chemistry)</i>	39
<i>Physical Science (Physics)</i>	40
DESE Statewide Articulation Agreements.....	42
Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)	43
Other	44
Reference Materials.....	44
Related National, Regional, and State Professional Organizations	44
Student Organizations.....	44
Selected Websites.....	44

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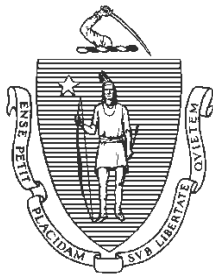
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Mitchell D. Chester, Ed.D.
Commissioner

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

Marine Service Technology Framework (VMRNS)

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 Marine Service and Boating Safety

- 2.A.01 Demonstrate marine services knowledge and safety skills.
 - 2.A.01.01 Identify and use marine and boating safety personal flotation devices (PFD) and apply related laws.
 - 2.A.01.02 Identify and use marine and boating vessel safety checklists.
 - 2.A.01.03 Identify, describe and follow marine and boating safety navigation procedures.
 - 2.A.01.04 Identify describe and follow marine and boating safety communication procedures.
 - 2.A.01.05 Identify and describe occupational safety precautions and procedures in safety color codes.
 - 2.A.01.06 Identify and describe occupational safety precautions and procedures in fire safety.
 - 2.A.01.07 Demonstrate the proper use of shop safety equipment.
 - 2.A.01.08 Identify chemicals that are commonly used in marine service.
 - 2.A.01.09 Demonstrate safe handling, storage and disposal procedures for chemicals.
 - 2.A.01.10 Describe the importance and demonstrate the use of Personal Protective Equipment (PPE) according to current industry and OSHA standards.

2.A.01 Performance Examples:

- Complete the MA boating safety course and pass the exam.
- Describe safety color codes and give examples of their applications.
- Describe occupational fire safety precautions and procedures in the marine service industry.
- Summarize OSHA, SDS, and EPA guidelines that affect the marine service industry.
- Perform handling, storage and disposal procedures for chemicals used in the marine service industry. according to current industry and OSHA standards.

2.B Fundamentals of Hand Tools, Power Tools, Fasteners and Measuring Procedures

- 2.B.01 Compare and contrast fasteners.
 - 2.B.01.01 Identify commonly used threaded fasteners.
 - 2.B.01.02 Identify SAE and metric bolt head markings.
 - 2.B.01.03 Identify commonly used nuts and washers.
 - 2.B.01.04 Identify and describe commonly used snap rings, cotter pins and retainers.
 - 2.B.01.05 Identify and describe the types of torque wrenches and explain and demonstrate the basic rules to follow when using them.

2.B.01 Performance Example:

- Torque fasteners according to manufacturer's specifications and according to sequence.

- 2.B.02 Demonstrate measuring procedures.
 - 2.B.02.01 Describe commonly used low precision measuring tools.
 - 2.B.02.02 Identify an outside and inside caliper and demonstrate their use.
 - 2.B.02.03 Identify a feeler gauge and demonstrate its use.
 - 2.B.02.04 Identify a hole gauge and demonstrate its use.
 - 2.B.02.05 Identify a telescoping/snap gauge and demonstrate its use.
 - 2.B.02.06 Identify a vernier caliper and demonstrate its use.
 - 2.B.02.07 Identify an outside micrometer and demonstrate its use.
 - 2.B.02.08 Identify a depth indicator gauge and demonstrate its use.
 - 2.B.02.09 Identify a dial indicator and demonstrate its use.

2.B.02 Performance Example:

- Demonstrate measurement skills using a variety of measuring procedures.

2.B.03 Demonstrate the use of hand tools.

- 2.B.03.01 Identify and use various types of screwdrivers.
- 2.B.03.02 Identify and use various types of pliers.
- 2.B.03.03 Identify and use various types of wrenches.
- 2.B.03.04 Identify and use various types of punches and chisels.
- 2.B.03.05 Identify and use various types of hammers.
- 2.B.03.06 Identify and use various types of sockets.
- 2.B.03.07 Identify and use various types of extensions.
- 2.B.03.08 Identify and use various various types of files.
- 2.B.03.09 Identify and use various types of hacksaws.
- 2.B.03.10 Identify and use various various types of thread cutting taps and dies.
- 2.B.03.11 Identify and use a tubing cutter, double flaring tool and ISO flaring tool.
- 2.B.03.12 Identify and use different types of gasket scrapers.
- 2.B.03.13 Identify and use various types of wire brushes.
- 2.B.03.14 Identify and use various types of bench vises.

2.B.03 Performance Examples:

- Select the appropriate hand tool to complete an assigned task.
- Demonstrate the use of the hand tool.

2.B.04 Demonstrate the use of power tools.

- 2.B.04.01 Identify and explain the purpose of an air impact wrench.
- 2.B.04.02 Identify types of drill bits.
- 2.B.04.03 Describe the difference in drilling speed for different metals.
- 2.B.04.04 Describe safety procedures to be followed when using an electric drill.
- 2.B.04.05 Drill holes to given specifications using an electric drill.
- 2.B.04.06 Identify and explain the purpose of impact sockets.
- 2.B.04.07 Describe maintenance and safety procedures when using an air impact wrench.
- 2.B.04.08 Identify and explain the purpose of an electric soldering iron.
- 2.B.04.09 Describe safety procedures to be followed when using an electric soldering iron.
- 2.B.04.10 List the type of solder to use when soldering electrical component.
- 2.B.04.11 Identify and explain the purpose of a bench grinder.
- 2.B.04.12 Describe safety procedures to follow when using a bench grinder.

2.B.04 Performance Examples:

- Select the correct power tool to match assigned task.
- Demonstrate the correct use of the power tool selected according to current industry and OSHA standards..

2.C Fundamentals of Shop Practices to Industry Standards

2.C.01 Describe and demonstrate shop practices to industry standards.

- 2.C.01.01 Explain watercraft safety practices (Massachusetts Boating Safety Certification) and navigation.
- 2.C.01.02 Remove broken fasteners and install helicoils and similar inserts.
- 2.C.01.03 Locate, read, interpret and use parts and service manuals, electronic parts manuals, computer data, when procuring parts for the system being worked on.
- 2.C.01.04 Accurately document performed repairs using repair orders, invoices and other common forms.

- 2.C.01 Performance Examples:
- Identify and explain water safety practices.
 - Identify and demonstrate the use of industry manuals and commonly used forms.

2.D Fundamentals of Marine Service Maintenance Areas

- 2.D.01 Conduct preventative maintenance.
- 2.D.01.01 Perform basic vessel inspections according to current industry and OSHA standards.
 - 2.D.01.02 Identify and service waste systems.
 - 2.D.01.03 Describe winterizing procedures for vessels.
 - 2.D.01.04 Describe winterizing procedures for potable water, waste, and wash down systems.
 - 2.D.01.05 Inspect engine mounts/chocks and alignment.
 - 2.D.01.06 Inspect cranking motor mounting bolts and electrical connections.
 - 2.D.01.07 Service and/or replace sparkplugs.
 - 2.D.01.08 Check and adjust linkage.
 - 2.D.01.09 Service flame arrestor.
 - 2.D.01.10 Inspect and replace hoses and connectors.
 - 2.D.01.11 Inspect, service and adjust belts.
 - 2.D.01.12 Remove/inspect and replace hoses and clamps.
 - 2.D.01.13 Demonstrate how to shrinkwrap boats.
 - 2.D.01.14 Demonstrate how to clean, wax and buff boats.

- 2.D.01 Performance Examples:
- Perform preventative maintenance and vessel inspections.
 - Inspect and replace spark plugs, belts, hoses and clamps.
 - Perform detailing on vessels and shrinkwrapping.

- 2.D.02 Maintain marine fuel and lubrication systems.
- 2.D.02.01 Explain Coast Guard fuel systems regulations.
 - 2.D.02.02 Describe marine fuels, engine oils, and their related systems including service and repair, and mix ratios.
 - 2.D.02.03 Service, repair, troubleshoot, and/or replace fuel and lubrication systems and evaluate marine fuels and lubricating oils.
 - 2.D.02.04 Remove/repair oil pump, pan and/or gasket.

- 2.D.02 Performance Example:
- Identify, service, repair and troubleshoot marine fuel systems.

- 2.D.03 Maintain marine ignition systems.
- 2.D.03.01 Troubleshoot, service and repair stern drive/inboard ignition systems.
 - 2.D.03.02 Perform timing and synchronizing using manual.
 - 2.D.03.03 Repair, service and bench test distributor.
 - 2.D.03.04 Inspect primary and secondary circuits.
 - 2.D.03.05 Remove, repair and reinstall distributors.
 - 2.D.03.06 Remove, replace and check control modules.

- 2.D.03 Performance Examples:
- Repair ignition systems and perform timing and synchronizing according to manufacturers' specifications.
 - Repair and replace bench test distributor, secondary circuits, distributors and control modules.

- 2.D.04 Maintain marine electrical systems.
- 2.D.04.01 Read and interpret A.B.Y.C. wiring codes and regulations.
 - 2.D.04.02 Read and interpret electrical meters.
 - 2.D.04.03 Charge, test, and evaluate engine lead-acid batteries.
 - 2.D.04.04 Read electrical schematics.
 - 2.D.04.05 Test and clean terminals and service battery.
 - 2.D.04.06 Test, repair, and replace neutral safety switch.
 - 2.D.04.07 Test, repair, and replace charging system components.
 - 2.D.04.08 Install, troubleshoot, service, and repair electrical systems, starting systems, and marine instrumentation.

2.D.04 Performance Example:

- Troubleshoot, service and repair electrical systems, starting systems and marine instrumentation.

- 2.D.05 Maintain cooling systems.
- 2.D.05.01 Describe cooling system operations.
 - 2.D.05.02 Perform winterizing procedures on cooling systems.
 - 2.D.05.03 Diagnose, service, and repair raw water systems and closed cooling system.
 - 2.D.05.04 Troubleshoot, service, and repair outboard, sterndrive, and inboard cooling and exhaust systems.

2.D.05 Performance Example:

- Identify procedures in maintaining all cooling systems.

- 2.D.06 Maintain drive systems.
- 2.D.06.01 Describe drive systems and explain the theory of operation for marine applications.
 - 2.D.06.02 Inspect and service drive train.
 - 2.D.06.03 Inspect and troubleshoot all drive system component parts.
 - 2.D.06.04 Inspect, troubleshoot, and service gear cases on marine drive systems.
 - 2.D.06.05 Check/align engine as required for acceptance of outdrive.
 - 2.D.06.06 Tune-up stern drive, outboard, and inboard engine systems.
 - 2.D.06.07 Troubleshoot and repair transom plate systems.
 - 2.D.06.08 Diagnose, service, repair, and adjust outboard shift lower units and throttle systems.
 - 2.D.06.09 Service/repair outboard lower units.
 - 2.D.06.10 Demonstrate the removal and installation procedures for stern drives.
 - 2.D.06.11 Service/repair transom plate, gimble ring, and bell ring.
 - 2.D.06.12 Service/repair upper gear housings.

2.D.06 Performance Examples:

- Identify and service all marine drive systems.
- Demonstrate the removal and installation of stern drives.

- 2.D.07 Maintain tilt and trim systems.
- 2.D.07.01 Inspect, test, service, and repair/replace power trim tilt systems, including midsections and lines.
 - 2.D.07.02 Describe how trim systems affect different hull configurations.

2.D.07 Performance Example:

- Repair/ replace trim tilt system.

- 2.D.08 Maintain steering systems.
 - 2.D.08.01 Service/repair marine cable steering systems.
 - 2.D.08.02 Service/repair marine hydraulic steering systems.
 - 2.D.08.03 Service/repair marine steering accessories.

- 2.D.08 Performance Example:
- Identify and service steering systems.

2.E Fundamentals of Overhaul of Four and Two Stroke Engines

- 2.E.01 Overhaul four stroke cycle engines.
 - 2.E.01.01 Identify characteristics and cycles of the four stroke cycle engine.
 - 2.E.01.02 Disassemble/reassemble a four stroke cycle engine.
 - 2.E.01.03 Diagnose valve and head problems using the compression and leak down testers.
 - 2.E.01.04 Remove and inspect cylinder head and gasket.
 - 2.E.01.05 Remove, clean and inspect all internal components, connecting rods, pistons, camshaft, bearings and crankshaft.
 - 2.E.01.06 Precision measure internal engine components.
 - 2.E.01.07 Measure bearing clearance with plastigauge.
 - 2.E.01.08 Hone and clean cylinders.
 - 2.E.01.09 Check crankshaft end play for run-out.
 - 2.E.01.10 Install pistons on piston pins and check orientation; install rings on pistons.
 - 2.E.01.11 Install oil seals.
 - 2.E.01.12 Demonstrate overhaul diagnostic and service procedures for four stroke cycle engines.
 - 2.E.01.13 Diagnose failure analysis.

- 2.E.01 Performance Examples:
- Identify a four stroke cycle engine, disassemble and reassemble a four stroke cycle engine and diagnose valve and head problems using leak down testers.
 - Remove, clean and inspect all internal components, connecting rods, pistons, camshaft, bearings and crankshaft.
 - Precision measure internal engine components, measuring bearing clearance with plastigauge.
 - Install pistons on piston pins and check orientation; install rings on pistons and install oil seals.
 - Identify overhaul diagnostic and service procedures for four stroke cycle engines and diagnose failure analysis

- 2.E.02 Overhaul two stroke cycle engines.
 - 2.E.02.01 Identify characteristics and cycles of the two stroke cycle engine.
 - 2.E.02.02 Diagnose engine combustion chamber problems using the compression tester method.
 - 2.E.02.03 Remove, clean and inspect cylinder heads for cracks, warped surfaces and damage to spark plug threads.
 - 2.E.02.04 Disassemble two stroke cycle engines.
 - 2.E.02.05 Demonstrate diagnostic and service procedures for two stroke cycle engines.
 - 2.E.02.06 Inspect, clean and measure pistons, connecting rods, crankshaft, bearing surfaces, piston pins and all related components.
 - 2.E.02.07 Measure cylinders for out-of-round, taper and examine ports.
 - 2.E.02.08 Hone and clean cylinders.
 - 2.E.02.09 Inspect and clean intake manifold; check/replace reed valves.
 - 2.E.02.10 Reassemble engine to factory specifications.

- 2.E.02 Performance Examples:
- Disassemble two stroke cycle engines, diagnose and apply service procedures for two stroke cycle engines.
 - Disassemble and reassemble two stroke cycle engines to factory specifications.

2.F **Fundamentals of all Fuel Systems in Marine Services**

- 2.F.01 Maintain and repair outboard fuel systems.
- 2.F.01.01 Remove, disassemble, clean and rebuild outboard carburetors.
 - 2.F.01.02 Adjust, synchronize and lubricate throttle linkages and check for proper operation.
 - 2.F.01.03 Check, inspect and repair fuel lines, fuel filters and fuel tanks.
 - 2.F.01.04 Test, inspect and repair oil injection systems.
 - 2.F.01.05 Diagnose, inspect and repair outboard EFI fuel systems.
 - 2.F.01.06 Diagnose, inspect and repair outboard direct fuel injection systems.
 - 2.F.01.07 Service and inspect vapor separated tank.

- 2.F.01 Performance Examples:
- Disassemble, clean and rebuild outboard carburetors and then adjust, synchronize and lubricate throttle linkages and check for proper operation.
 - Test, diagnose, inspect and repair oil injection systems, outboard EFI fuel systems and outboard direct fuel injection systems.

- 2.F.02 Maintain and repair inboard and stern drive fuel systems.
- 2.F.02.01 Maintain, inspect and repair fuel lines, fuel tanks, and anti-siphon systems and fuel filters.
 - 2.F.02.02 Remove, inspect and repair carburetors.
 - 2.F.02.03 Check and adjust carburetor linkages and choke systems.
 - 2.F.02.04 Maintain, inspect and repair EFI Throttle Body fuel systems.
 - 2.F.02.05 Maintain, inspect and repair Multi-Port fuel injection systems.

- 2.F.02 Performance Examples:
- Inspect and repair fuel lines, fuel tank, anti-siphon systems, fuel filters, carburetors, EFI throttle body fuel systems and multi-port fuel injection systems.
 - Inspect, repair and adjust carburetors, carburetor linkages and choke systems

- 2.F.03 Describe and apply marine diesel engine technology.
- 2.F.03.01 Describe principles of operation.
 - 2.F.03.02 Describe and identify turbocharger, intercooler and supercharger.
 - 2.F.03.03 Explain two stroke and four stroke diesel engines.
 - 2.F.03.04 Describe and identify internal engine components.
 - 2.F.03.05 Perform compression test.
 - 2.F.03.06 Inspect and service valve train.
 - 2.F.03.07 Explain, identify and trouble shoot fuel systems.
 - 2.F.03.08 Change fuel filters and bleed fuel system.
 - 2.F.03.09 Identify and explain lubrication system.
 - 2.F.03.10 Diagnose, service and repair electrical system.
 - 2.F.03.11 Identify and explain electrical system.
 - 2.F.03.12 Check cold start system.

- 2.F.03 Performance Examples:
- Identify and explain two and four stroke diesel engines and identify internal engine components.
 - Perform compression test and inspect service valve train.
 - Troubleshoot fuel system, change fuel filters and bleed fuel system.
 - Identify and explain lubrication system and check cold start system.
 - Diagnose and repair electric system.
 - Identify and explain lubrication system and check cold start system.

2.G **Fundamentals of ARC, MIG and TIG Welding**

- 2.G.01 Describe and demonstrate welding and cutting fabrication.
- 2.G.01.01 Explain ARC welding and its function.
- 2.G.01.02 Demonstrate various ARC welding techniques in multiple positions using various welding rods.
- 2.G.01.03 Explain MIG (Metal Inert Gas) welding and its function.
- 2.G.01.04 Demonstrate various MIG welding techniques in multiple positions.
- 2.G.01.05 Explain TIG (Tungsten Inert Gas) welding and its function.
- 2.G.01.06 Demonstrate various TIG welding techniques in various positions using A/C and D/C electricity.
- 2.G.01.07 Explain and demonstrate the use of a plasma cutter.
- 2.G.01.08 Explain oxygen/acetylene torches and their functions.
- 2.G.01.09 Demonstrate lighting, heating and cutting operation according to current industry and OSHA standards.

- 2.G.01 Performance Examples:
- Explain and demonstrate various ARC welding techniques in multiple positions using various welding rods.
 - Explain and demonstrate MIG and TIG welding techniques and their function and proper use of plasma cutter, proper light, heating and cutting operation.
 - Identify and explain oxygen/acetylene torches and their function.

2.H **Fundamentals of Boatbuilding and Repair**

- 2.H.01 Describe and demonstrate fiberglass maintenance, repair and boatbuilding.
- 2.H.01.01 Identify, describe and demonstrate the use of fiberglass materials, chemicals and tools.
- 2.H.01.02 Identify the characteristics and demonstrate the uses of: polyester, vinylester and epoxy resins, solvents, additives and release agents.
- 2.H.01.03 Compare and contrast characteristics of fiberglass boatbuilding methods.
- 2.H.01.04 Explain and perform gel coat applications, maintenance and repair procedures.
- 2.H.01.05 Explain and perform laminating procedures.
- 2.H.01.06 Explain and perform secondary repairs of cured fiberglass laminates.
- 2.H.01.07 Describe plug and mold construction and maintenance.

- 2.H.01 Performance Examples:
- Demonstrate the use of fiberglass materials, chemicals and tools according to current industry and OSHA standards.
 - Perform proper gel coat applications, maintenance and repair procedures.

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.C.01	W.11-12.2 W.11-12.4 L.11-12.1 L.11-12.2 L.11-12.3 L.11-12.4 L.11-12.6	Writing Standards (W) Language Standards (L)
Performance Example: <ul style="list-style-type: none"> • Explain watercraft safety practices (Massachusetts Boating Safety Certification) and navigation. 		
2.C.01	RI.11-12.1 RI.11-12.3 RI.11-12.4 RI.11-12.6 RI.11-12.7 RI.11-12.10	Reading Standards for Informational Texts (RI)
Performance Example: <ul style="list-style-type: none"> • Locate, read, interpret, and use parts and service manuals, electronic parts manuals, computer data, when procuring parts for the system being worked on. 		
2.D.02	W.11-12.2 W.11-12.4 L.11-12.1 L.11-12.2 L.11-12.3 L.11-12.4 L.11-12.6	Writing Standards (W) Language Standards (L)
Performance Example: <ul style="list-style-type: none"> • Explain Coast Guard fuel systems regulations. 		
2.D.04	RI.11-12.1 RI.11-12.3 RI.11-12.4 RI.11-12.6 RI.11-12.7 RI.11-12.10	Reading Standards for Informational Texts (RI)
Performance Example: <ul style="list-style-type: none"> • Read and interpret A.B.Y.C. wiring codes and regulations. 		

2.F.03	W.11-12.2 W.11-12.4 L.11-12.1 L.11-12.2 L.11-12.3 L.11-12.4 L.11-12.6	Writing Standards (W) Language Standards (L)
Performance Example: <ul style="list-style-type: none"> Describe principles of operation. 		
2.H. 01	W.11-12.2 W.11-12.4 L.11-12.1 L.11-12.2 L.11-12.3 L.11-12.4 L.11-12.6	Writing Standards (W) Language Standards (L)
Performance Example: <ul style="list-style-type: none"> Compare and contrast characteristics if fiberglass boatbuilding methods. 		

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.B.02	N-Q-3 N-Q-3	Number and Quantity
Performance Example: <ul style="list-style-type: none"> When using measurement devices such as vernier calipers, feeler gauges, and micrometers, choose a level of accuracy appropriate to limitations on measurement when reporting quantities. 		
2.B.04	F-IF-5	Interpreting Functions
Performance Example: <ul style="list-style-type: none"> Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, the function used to show the number of person-hours it takes to assemble n engines in a factory or the number of person-hours required to overhaul an engine or perform other major repairs on a marine vessel. 		
2.D.02	N-Q-1	Quantities
Performance Example: <ul style="list-style-type: none"> Use units as a way to understand problems and to guide the solution of multi-step problems; when working with marine fuels and engine oil mix ratios, choose and interpret units consistently in formulas. 		
2.A.09.01 2.A.09.02	A-CED-4 A-CED-4	Creating Equations
Performance Example: <ul style="list-style-type: none"> When installing, troubleshooting, servicing or repairing electrical systems, starting systems, and marine instrumentation, it may be necessary to rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange OHM's law $V=IR$ to highlight resistance R. 		
2.E.01 2.E.02	A-CED-1 A-CED-2 A-CED-3	Creating equations
Performance Example: <ul style="list-style-type: none"> When diagnosing valve and head problems during overhaul of four and two stroke engines, it will help to create equations in one variable and use them to solve problems. Create equations in two or more variables to represent relationships between quantities. Represent constraints by equations and interpret solutions 		

as viable or non-viable options while performing diagnostic failure analysis on the engine.		
2.G.01	G-GMD-3	Geometric Measurement and Dimension
Performance Example: <ul style="list-style-type: none"> When performing welding and cutting fabrication (ex.: ARC welding, MIG welding, and TIG welding) use volume formulas for cylinders, pyramids, cones, spheres and other three dimensional objects to solve problems. 		
2.H. 01	G-MG-3	Modeling with Geometry
Performance Example: <ul style="list-style-type: none"> When performing repairs on a boat using fiberglass, epoxy resins, solvents, additives, and release agents, apply geometric methods to solve design problems. For example, designing an object or structure to satisfy physical constraints or minimize cost. 		

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.D.02	Biology 1.2	The Chemistry of Life (carbohydrates: lubricants and fuels)
Performance Example: <ul style="list-style-type: none"> Utilizing basic knowledge of carbohydrates, their viscosities and or energy contents, determine the appropriate fuel or lubricant for a given application. Utilizing laboratory mathematics, figure the correct volume of fuel to lubricant to achieve the desired ratio when mixing fuel for two-stroke engines. Perform labs to determine the chemistry of life of carbohydrates: lubricants and fuels. 		
2.F.03	Biology 1.2	The Chemistry of Life (carbohydrates: lubricants and fuels)
Performance Examples: <ul style="list-style-type: none"> Utilizing knowledge of marine biologic action on fuel and lubrication systems, determine if fuel samples and lubricating oil samples are contaminated and in need of replacement. Perform labs to determine the chemistry of life of carbohydrates: lubricants and fuels. 		

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.D.02	Chemistry 7.1 7.4 8.4	Solutions, Rates of Reaction, and Equilibrium Acids and Bases and Oxidation-Reduction Reactions
Performance Example: <ul style="list-style-type: none"> Utilizing basic knowledge of carbohydrates, and their viscosities and/or energy contents, determine the appropriate fuel or lubricant for a given application. Utilizing laboratory mathematics, figure the correct volume of fuel to lubricant to achieve the desired ratio when mixing fuel for two-stroke engines. 		
2.D.04	Chemistry 8.4	Acids and Bases and Oxidation-Reduction Reactions
Performance Example: <ul style="list-style-type: none"> Utilizing knowledge of electrochemical reactions, troubleshoot lead-acid batteries to determine if replacement of electrolyte or cathode or anode decay is the reason for a loss of battery power. 		

2.E.01	Chemistry 8.4	Acids and Bases and Oxidation-Reduction Reactions
Performance Example: <ul style="list-style-type: none"> Utilizing basic knowledge of chemical reactions in an internal combustion engine, determine if engine has undergone chemical damage from improper coolant or coolant contamination to the engine. 		
2.F.01	Chemistry 5.5 6.1 6.2 6.4 7.5 8.4	Chemical Reactions and Stoichiometry States of Matter, Kinetic Molecular Theory, and Thermochemistry Solutions, Rates of Reaction, and Equilibrium Acids and Bases and Oxidation-Reduction Reactions
Performance Example: <ul style="list-style-type: none"> Utilizing knowledge of basic combustion reactions, troubleshoot diesel engines to determine if proper fuel and air ratio's (stoichiometric balance) is achieved. 		
2.G.01	Chemistry 7.5 8.4 6.4 8.4	Solutions, Rates of Reaction, and Equilibrium Acids and Bases and Oxidation-Reduction Reaction States of Matter, Kinetic Molecular Theory, and Thermochemistry Solutions, Rates of Reaction, and Equilibrium Acids and Bases and Oxidation-Reduction Reactions
Performance Example: <ul style="list-style-type: none"> Utilizing knowledge of oxidation reactions and their unintended effects on metals, weld a surface utilizing ARC, MIG or TIG techniques and determine if any potential damage to substrate material results. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.D.01	Physics 1.4 1.5	Motion and Forces
Performance Example: <ul style="list-style-type: none"> Create equations in one variable and use them to solve problems for marine fuel systems. 		
2.D.04	Physics 5.2 5.3 5.5	Electromagnetism (Ohm's Law and Coulombs Law and Power) Electromagnetism Electromagnetism (Charge and Voltage)
Performance Example: <ul style="list-style-type: none"> Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations for marine fuel systems. 		
2.D.05	Physics 1.4 1.8 3.1 3.2 3.3 3.4	Motion and Forces (Forces and circular motion in pumps) Heat and Heat Transfer
Performance Example: <ul style="list-style-type: none"> Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations for marine fuel systems. 		
2.D.06	Physics 1.4 1.8	Motion and Forces (Linear and Circular)
Performance Example: <ul style="list-style-type: none"> Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations for marine fuel systems. 		

2.D.07	Physics	1.8	Motion and Forces (Forces and Vectors)
Performance Example:			
<ul style="list-style-type: none">• Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations for marine fuel systems.			

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

- American Boat and Yacht Council Certification
- American Boat Builders & Repairers Association: Marine Diesel Certification, Service Manger Certification Composite and Fiberglass repair Certification
- Mercury Marine Certification Association of Marine Technicians (AMTECH)

Other

Reference Materials

- Honda Marine Shop Manual
Published by Honda Motor Co, LTD
- Johnson Evinrude Outboard Manual Service Manual
Published by Outboard Marine Corporation
- Mercury Outboard Service Manual
Publish by Mercurymarine
- SELOC Marine Repair Manual
By SELOC Publishing
- Mercruiser Stern Drive Shop Manual
Published by Mercurymarine
- Volvo Penta Stern Drive Service Manual
Published by Volvo Penta
- The Fiberglass Boat Repair Manual [Hardcover]
Allan H. Viatses
- Fiberglass Boat Repairs Illustrated [Paperback]
Roger Marshall

Related National, Regional, and State Professional Organizations

- Cape Cod Marine Trades
- Mass Marine Trades
- ABBRA: American Boat Boulders and Repairers Association
- Sea Cadets: US Naval Sea Cadets
- United States Power Squadron
- NMMA: National Marine Manufacturers Association
- ABYC: American Boat and Yacht Council

Student Organizations

- Skills USA www.maskillsusa.org

Selected Websites

- www.uscg.mil
- www.diesel.org
- www.accsc.org
- www.natef.org
- www.bls.gov
- www.marad.dot.gov
- www.americanwaterways.com