



Vocational Technical Education Framework



Transportation Occupational Cluster

Automotive Collision Repair & Refinishing (VCOLL)

CIP Code 470603

June 2014

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.
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July 2014

Dear Colleagues,

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

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

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

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

Sincerely,

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

Introduction

Overview & Organization and Key Changes

Overview

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Organization and Key Changes

This section contains the following:

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

Highlights of Changes to the Vocational Technical Education Frameworks:

Strand One:

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

Automotive Collision Repair & Refinishing Framework (VCOLL)

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>
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- 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 Automotive Collision Specific Safety Practices

- 2.A.01 Identify, describe and apply safety practices related to types of automotive lifts and dedicated frame equipment according to current industry and OSHA standards.
 - 2.A.01.01 Demonstrate procedures for safe lift operations.
 - 2.A.01.02 Demonstrate safe use and storage of hydraulic floor jacks and safety stands.
 - 2.A.01.03 Apply manufacturer's safety procedures when using a dedicated frame machine.

2.A.01 Performance Example:

- Students will demonstrate safe automotive lifting procedures and dedicated frame equipment.

- 2.A.02 Identify and describe safety procedures when dealing with high pressure systems equipment according to current industry and OSHA standards.
 - 2.A.02.01 Describe and explain the importance of safety procedures to be used when servicing high pressure air conditioning systems.
 - 2.A.02.02 Demonstrate safe use when storing, handling and installing high-pressure gas cylinders.
 - 2.A.02.03 Identify and comply with environmental concerns and current industry and OSHA standards relating to refrigerants and coolants.

2.A.02 Performance Example:

- Students will safely evacuate and recharge an air conditioning system according to current industry and OSHA standards.

- 2.A.03 Identify and describe safety procedures when dealing with electric circuits.
 - 2.A.03.01 Describe safety procedures to be followed when servicing airbag/supplemental restraint systems.
 - 2.A.03.02 Describe safety awareness of high voltage circuits of electrical or hybrid electric vehicles and related safety precautions as per manufacturer's recommendations.

2.A.03 Performance Example:

- Student will safely disarm and reactivate an airbag system per manufacturer's

- 2.A.04 Describe and apply safety procedures when using all tools.
 - 2.A.04.01 Describe and apply safety procedures when using pneumatic tools.
 - 2.A.04.02 Describe and apply safety procedures when using electric tools.
 - 2.A.04.03 Describe and apply safety procedures when using hand tools.

2.A.04 Performance Example:

- Student will pass a written and performance test before working with all tools.

- 2.A.05 Describe safety equipment and procedure for refinishing operations.
 - 2.A.05.01 Select and use a National Institute for Occupational Safety and Health (NIOSH) approved personal sanding respirator.
 - 2.A.05.02 Inspect condition and operation of equipment.
 - 2.A.05.03 Perform maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation.

- 2.A.05.04 Select and use a NIOSH approved (Fresh Air Make-up System) personal painting/refinishing respirator system.
- 2.A.05.05 Perform maintenance in accordance with EPA40 CFR Part 63, Subpart HHHHHH(6H Rule) and applicable state and local regulation.

2.A.05 Performance Example:

- Student will select and use the personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.) in accordance with OSHA, federal, state and local regulations.

2.B Fasteners

2.B.01 Identify commonly used fasteners and related hardware.

- 2.B.01.01 Identify Society of Automotive Engineers (SAE) and metric threaded fasteners.
- 2.B.01.02 Identify commonly used nuts and washers.

2.B.01 Performance Examples:

- Student will choose the correct hardware to match the assigned task.

2.B.02 Identify, describe and use commonly used plastic clips and retainers.

- 2.B.02.01 Identify push type plastic clips.
- 2.B.02.02 Identify threaded type retainers.

2.B.02 Performance Example:

- Student will select and use specific plastic clips and retainers for the task.

2.B *Advanced Performance Example:

- Student will select and install manufacturer's specific fasteners for the task.

2.C Measuring Procedures

2.C.01 Demonstrate commonly used measuring tools.

- 2.C.01.01 Demonstrate and explain proper use of low precision measuring tools (steel ruler, tape measure).
- 2.C.01.02 Demonstrate and explain use of self-centering tram gauge.

2.C.01 Performance Example:

- Student will demonstrate measurement skills using both American and metric system using variety of low precision measuring tools.

2.C.02 Identify and describe accurate liquid measuring procedures.

- 2.C.02.01 Explain and demonstrate the calculation of mixing ratios.
- 2.C.02.02 Explain and demonstrate the calculation of percentage.

- 2.C.02 Performance Example:
- Student will demonstrate liquid measuring skills using mixing ratios and percentages.

- 2.C
- *Advanced Performance Examples:*
- Student will measure liquid materials.
 - Student will measure film thickness.

2.D Hand Tools

- 2.D.01 Describe and demonstrate the use of various types of screwdrivers according to current industry and OSHA standards.
- 2.D.01.01 Demonstrate and explain the use of a Phillips screwdriver.
 - 2.D.01.02 Demonstrate and explain the use of a flat screwdriver.
 - 2.D.01.03 Demonstrate and explain the use of a Torx screwdriver.

- 2.D.01 Performance Example:
- Student will pass a written and performance test before working with screwdrivers.

- 2.D.02 Describe and demonstrate the use of various types of pliers according to current industry and OSHA standards.
- 2.D.02.01 Demonstrate and explain the use of locking type pliers.
 - 2.D.02.02 Demonstrate and explain the use of channel type pliers.
 - 2.D.02.03 Demonstrate and explain the use of cutting pliers.
 - 2.D.02.04 Demonstrate and explain the use of needle nose pliers.

- 2.D.02 Performance Example:
- Student will pass a written and performance test before working with pliers.

- 2.D.03 Describe and demonstrate the use of various types of wrenches.
- 2.D.03.01 Demonstrate and explain the use of proper open end wrenches.
 - 2.D.03.02 Demonstrate and explain the use of combination wrenches.
 - 2.D.03.03 Demonstrate and explain the use of ratcheting type wrenches.
 - 2.D.03.04 Demonstrate and explain the use of torque wrenches.
 - 2.D.03.05 Demonstrate and explain the use of boxed wrenches.
 - 2.D.03.06 Demonstrate and explain the use of Allen type wrenches.

- 2.D.03 Performance Example:
- Student will pass a written and performance test before working with wrenches.

- 2.D.04 Describe and demonstrate the use of various types of hammering tools.
- 2.D.04.01 Demonstrate the use and knowledge of the different types of hammers.
 - 2.D.04.02 Demonstrate the use and knowledge of the different types of dollies.
 - 2.D.04.03 Demonstrate the use and knowledge of the different types of punches.
 - 2.D.04.04 Demonstrate the use and knowledge of the different types of chisels.

- 2.D.04 Performance Example:
- Student will pass a written and performance test before working with hammering tools.

- 2.D.05 Describe and demonstrate the use of various types of socket wrenches.
- 2.D.05.01 Demonstrate the use and knowledge of socket drive sizes.
 - 2.D.05.02 Demonstrate the use and knowledge of socket point types.

- 2.D.05.03 Demonstrate the use and knowledge of socket handles.
- 2.D.05.04 Demonstrate the use and knowledge of extensions and swivels.
- 2.D.05.05 Demonstrate the use and knowledge of impact sockets.

2.D.05 Performance Example:
 ▪ Student will pass a written and performance test before working with socket wrenches.

- 2.D.06 Describe and demonstrate the use of various metal working tools.
 - 2.D.06.01 Demonstrate the use and knowledge of various types of files.
 - 2.D.06.02 Demonstrate the use and knowledge of different types of hacksaws.
 - 2.D.06.03 Demonstrate the use and knowledge of various types of thread cutting taps.
 - 2.D.06.04 Demonstrate the use and knowledge of various types of thread cutting dies.
 - 2.D.06.05 Demonstrate the use and knowledge of different types of pry bars.

2.D.06 Performance Example:
 ▪ Student will pass a written and performance test before working with metal working tools.

2.D **Advanced Performance Example:*
 ▪ Student will apply available technology to find manufacturers specialty tool listings.

2.E Power Tools

- 2.E.01 Demonstrate and explain the use of various commonly used pneumatic or electric powered tools.
 - 2.E.01.01 Demonstrate and explain the use of commonly used sanders.
 - 2.E.01.02 Demonstrate and explain the use of commonly used grinders.
 - 2.E.01.03 Demonstrate and explain the use of commonly used buffers.
 - 2.E.01.04 Demonstrate and explain the use of commonly used impact ratchets and guns.
 - 2.E.01.05 Demonstrate and explain the use of commonly used cutting tools.
 - 2.E.01.06 Demonstrate and explain the use of high-volume, low pressure (HVLP) spray guns.
 - 2.E.01.07 Demonstrate and explain the use of blow guns.

2.E **Advanced Performance Examples:*
 ▪ Student will demonstrate cleaning a spray gun using the specified gun washer system.
 ▪ Student will demonstrate the use of dent removal equipment according to current industry and OSHA standards.

2.F Structural Damage

- 2.F.01 Set-up and measure structural damage using the appropriate measuring devices.
 - 2.F.01.01 Attach frame using anchoring devices.
 - 2.F.01.02 Analyze unibody dimensions using appropriate measuring devices per measuring system specifications.
 - 2.F.01.03 Determine the extent of damage to structural steel and body panels.

2.F.01 Performance Example:
▪ Student will safely set-up, measure and diagnose structural damage using appropriate measuring devices.

2.F *Advanced Performance Examples:
▪ Student will set-up and measure structural damage.
▪ Student will select and demonstrate the use of pulling equipment.

2.G Cutting and Welding

2.G.01 Identify weldable and non-weldable materials used in collision repair.
2.G.01.01 Weld and cut mild steel and high-strength steel and other metals using manufacturer's/industry specification.

2.G.01 Performance Example:
▪ Student will identify weldable and non-weldable materials.

2.G.02 Identify cutting and welding processes and equipment used for different materials and locations in accordance with manufacturer's/industry specification.
2.G.02.01 Determine the type of cutting process for the type of metal to manufacturer's specification.
2.G.02.02 Determine the joint type (butt weld with backing, lap, etc.) for each specific welding operation according to manufacturer's specifications.
2.G.02.03 Determine the type of weld (continuous, butt weld with backing plug, etc.) for each specific welding operation according to manufacturer's and industry specifications.
2.G.02.04 Explain the following welds: continuous, stitch, tack, plug, butt weld with backing and lap joints.

2.G.02 Performance Examples:
▪ Student will use body repair manuals or electronic software to look up proper cutting and welding procedures per the manufacturer's recommendations.

2.G.03 Set up welding equipment.
2.G.03.01 Determine the appropriate welder type, electrode, wire type, diameter and gas to be used in a specific welding situation.
2.G.03.02 Adjust the welder to "tune" for proper electrode stickout, voltage, polarity, flow-rate and wire-feed required for the material being welded.
2.G.03.03 Determine work clamp (ground) location and attach prep metal and work area for welding and make test welds.

2.G.03 Performance Example:
▪ Student will safely set-up and adjust a Metal Inert Gas (MIG) welder for a proper weld.

2.G.04 Prep metal and work area for welding, and make test welds.
2.G.04.01 Clean and prepare metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, and clamp as required.
2.G.04.02 Protect adjacent panels, glass, vehicle interior, etc., from welding and cutting operations.

2.G.04.03 Protect computers and other electronic control modules during welding procedures according to manufacturer's specifications.

2.G.04 Performance Example:
▪ Student will weld a test panel and perform a destructive test.

2.G.05 Make test welds and perform a destructive test.
2.G.05.01 Weld in the flat, horizontal, vertical, and overhead position using the proper angle of the gun to the joint and direction gun travel.
2.G.05.02 Explain the following welds: continuous, stitch, tack, plug, butt-weld with backing and lap joints.

2.G.05 Performance Example:
▪ Students will Weld in the flat, horizontal, vertical, and overhead position using the proper angle of the gun to the joint and direction gun travel.

2.G.06 Identify welding problems.
2.G.06.01 Identify the causes of splits and sputters, burn through, lack of penetration, porosity, incomplete fusion, excessive spatter, distortion and waviness of bead and make necessary adjustments.
2.G.06.02 Identify cause of contact tip burn-back and failure of wire to feed and make necessary adjustments.

2.G.06 Performance Example:
▪ Students will identify and correct splits and sputters, burn through, lack of penetration, porosity, incomplete fusion, excessive spatter, distortion and waviness of bead and make necessary adjustments.

2.G *Advanced Performance Example:
▪ Student will set-up and adjust various types of welders for various types of materials.

2.H Repair Plan

2.H.01 Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants from those areas to be repaired.
2.H.01.01 Wash entire vehicle with appropriate cleaning materials.

2.H.01 Performance Example:
▪ Student will soap and water wash the entire vehicle.

2.H.02 Develop and execute a repair plan.
2.H.02.01 Review damage report and analyze damage to determine appropriate methods for area to be repaired.
2.H.02.02 Identify paint code according to vehicle manufacturer's location.
2.H.02.03 Determine paint color with variant decks, mix paint and tint, if necessary, for a blendable match.
2.H.02.04 Inspect, remove and store exterior trim and moldings.
2.H.02.05 Remove, replace or adjust bolted-on panels.

2.H.02 Performance Example:
▪ Student will execute a repair plan to the assigned task.

- 2.H.03 Repair exterior panel cosmetic repair.
- 2.H.03.01 Straighten and rough-out contours of damaged panel to a surface condition for body filling or metal finishing using power tools, hand tools, and weld-on pull attachments.
 - 2.H.03.02 Remove paint from the damaged area of a body panel.
 - 2.H.03.03 Weld cracked or torn steel body panels; repair broken welds.
 - 2.H.03.04 Locate and reduce surface irregularities on a damaged body panel.
 - 2.H.03.05 Demonstrate hammer and dolly techniques.
 - 2.H.03.06 Mix and apply body filler.
 - 2.H.03.07 Sand body filler to match the contour of the vehicle.
 - 2.H.03.08 Mask area for primer.
 - 2.H.03.09 Featheredge broken areas with designated grits of sandpaper to prepare for primer.
 - 2.H.03.10 Restore corrosion protection.

2.H.03 Performance Examples:

- Student will demonstrate a minor dent repair using various body repair methods.
- Student will safely prep substrate for primer-surfacer and prime the panel following paint manufacturer's recommendations.

2.H *Advanced Performance Examples:

- Student will generate an estimate using various methods.
- Student will prepare a repair plan using manufacturer's recommended procedures.

2.I Mechanical and Electrical Components

- 2.I.01 Identify and explain common suspension and braking components.
- 2.I.01.01 Identify suspension system fasteners that should not be reused.
 - 2.I.01.02 Identify suspension types and components.
 - 2.I.01.03 Identify brakes components and damaged parts.
 - 2.I.01.04 Reinstall wheel and torque lug nuts according to manufacturer's specifications.

2.I.01 Performance Examples:

- Student will pass a written test on identifying suspension and brake components.
- Student will remove and install a tire/wheel assembly using the torque sequence per manufacturer's recommendations.

- 2.I.02 Identify electrical systems components.
- 2.I.02.01 Inspect, clean and replace or change a battery.
 - 2.I.02.02 Inspect, clean and repair or replace battery cables, connectors and clamps.
 - 2.I.02.03 Aim headlamp assemblies and fog/driving lamps; determine needed repairs.
 - 2.I.02.04 Check operation of power or manual options in vehicle such as locks, windows, mirrors, etc.

2.I.02 Performance Examples:

- Students will safely remove, inspect and install a battery.
- Student will properly adjust headlight assembly.

- 2.I.03 Heating and air conditioning systems.
 - 2.I.03.01 Identify alternating current (A/C) components.
 - 2.I.03.02 Identify cooling system components.

2.I.03 Performance Example:

- Student will pass a written test on identifying heating and air conditioning components.

- 2.I.04 Identify vehicle restraint systems.
 - 2.I.04.01 Disable and enable airbag systems per manufacturer's specifications.

2.I.04 Performance Examples:

- Student will properly disable and enable an airbag system per manufacturer's recommendation.

2.I **Advanced Performance Examples:*

- *Student will properly identify and diagnose restraint systems diagnostic trouble codes using manufacturer's recommendations.*

2.J Plastics and Adhesives

- 2.J.01 Identify the types of plastics used in vehicles and determine their repairability.
 - 2.J.01.01 Explain plastic repair using product manufacturer's recommendations.

2.J.01 Performance Example:

- Student will identify the type of plastic and choose the welder for the task according to current industry standards and manufacturer's specifications.

2.J **Advanced Performance Example:*

- Student will demonstrate the ability to repair plastics using appropriate methods per manufacturer's recommendations.

2.K Automotive Refinishing

- 2.K.01 Mix and apply undercoats per paint manufacturer's recommendations.
 - 2.K.01.01 Select, mix and apply appropriate undercoat.

2.K.01 Performance Example:

- Student will mix and apply undercoats per paint manufacturer's recommendations and current industry and OSHA standards.

- 2.K.02 Dry or wet sand area to which top coat will be applied.
 - 2.K.02.01 Select appropriate grit sandpaper and apply sanding techniques.

2.K.02 Performance Examples:

- Demonstrate the sanding techniques using the appropriate grit sandpaper according to manufacturer's recommendations and current industry and OSHA standards.

- 2.K.03 Clean area to be refinished using cleaning solution.
 - 2.K.03.01 Select and use final cleaning solution.

2.K.03 Performance Example:

- Student will final prep surface for refinishing according to current industry and OSHA standards.

2.K.04 Explain and demonstrate procedures for blending a panel per paint manufacturer's recommendations and current industry and OSHA standards.

2.K.04.01 Blend basecoat into adjacent panel.

2.K.04 Performance Example:

- Student will demonstrate the ability to blend the paint within a panel.

2.K.05 Explain and demonstrate procedures for overall panel refinishing per paint manufacturer's recommendations and current industry and OSHA standards.

2.K.05.01 Refinish entire panel with basecoat clear coat.

2.K.05 Performance Example:

- Student will apply topcoat to a prepared surface using paint manufacturer's specification.

2.K.06 Identify, diagnose and repair paint problems.

2.K.06.01 Identify blistering (i.e., raising of the paint surface); determine the cause(s) and correct condition.

2.K.06.02 Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition.

2.K.06.03 Identify the presence of fish-eyes (crater-like opening) in the finish; determine the cause(s) and correct the condition.

2.K.06.04 Identify solvent popping in freshly painted surface; determine the cause(s) and correct the condition.

2.K.06.05 Identify sags and runs and orange peel in the paint surface; determine the cause(s) and correct the condition.

2.K.06 Performance Example:

- Student will identify paint-related problems using illustrations from workbooks or computer programs.

2.K **Advanced Performance Example:*

- *Student will choose r equipment and techniques for custom painting.*

2.L Final Detail

2.L.01 Identify dirt or dust in the paint surface.

2.L.01.01 De-nib, buff and polish finishes, where necessary, to remove imperfections such as runs, sags, orange peel and dirt.

2.L.01 Performance Example:

- Student will identify dust problems in the paint using illustrations from workbooks or computer programs.

2.L.02 Identify and remove/repair buffing related imperfections (e.g., swirls marks, wheel burns).

2.L.02.01 Remove buffing related imperfections.

2.L.02 Performance Examples:

- Student will identify buffing-related problems in the paint using illustrations from workbooks, computer programs or a video.
- Student will wet sand and buff surface imperfections in paint.

2.L.03 Identify and remove/repair overspray conditions.

2.L.03.01 Remove overspray.

2.L.03 Performance Example:

- Student will properly remove overspray from a vehicle.

2.L.04 Demonstrate the application of decals, transfers, tapes, pinstripes (painted and taped), etc.

2.L.04.01 Apply decals, transfers, tapes, pinstripes.

2.L.04 Performance Example:

- Student will apply decals and pin striping tape.

2.L.05 Detail interior, exterior, body openings and glass.

2.L.05.01 Demonstrate the use of cleaners and techniques to clean interior and exteriors of the vehicles following current industry and OSHA standards.

2.L.05 Performance Example:

- Student will perform a final detail on a vehicle using a check list.

2.L. **Advanced Performance Example:*

- Student will verify that all documentation on the repair order and billing is complete.

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
2B	RST 9 Grades 6 – 8	Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic.
2I	RST 7 Grades 6 -8	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
2B, 2C, 2D, 2E, 2I, 2K	SL 1 Grades 9 -10 (a – e)	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
2B, 2C, 2D, 2E, 2I, 2J, 2K	SL 4 Grades 9 - 10	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • After viewing a video clip on technical tasks, students will, in a group discussion, identify the difference between one technical measuring technique and tool versus another. • Using expert grouping, students will read technical texts describing components and a process then specifically identify those components and processes within the text’s diagrams and charts. • In a group oral report project, students will demonstrate understanding of the specifics to a given technical task by explaining the procedures in a step by step process using domain specific words and phrases. • In a group or individually, students will orally cite to the teacher or the class, an understanding of a technical task being performed in the career area setting by summarizing the process and using domain specific words and phrases. 		
2C, 2D, 2G	RST 7 Grades 9 – 10	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
2C, 2D, 2G, 2I, 2L	RST 3 Grades 6 – 8	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
2D, 2E, 2I, 2K	SL 1 Grades 11 -12 (a – e)	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
2D, 2E, 2I, 2K	SL 4 Grades 11 – 12	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal

2B,2D, 2E, 2G,2H, 2I, 2K, 2L	L 6 Grades 9 - 10	tasks. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students will read vehicle and manufacturer’s recommendations then follow a technical task, from start to finish, with accuracy and precision according to those recommendations. • Students will read textbook and manufacturer’s recommendations and procedures then perform basic technical tasks accurately. • Students will orally cite a group persuasive presentation, to the instructor and/or the class, demonstrating how a technician proficiently performs a task using a variety of hand and more advanced technical tools best suited to the given technical task. • Using a portable whiteboard activity format, students are presented an exact technical task to perform, they will document the variety of technical tools they have chosen to perform that task, and explain to the instructor how the chosen tools will complete the technical task with precision. • Students will use domain specific words and phrases accurately when performing technical tasks/procedures in the career area setting, whether working with classmates, instructors or clients. 		
2D, 2E, 2G, 2H, 2I, 2K, 2L,	L6 Grades 11 – 12	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
2E, 2G, 2J, 2K,	RST 2 Grades 11 – 12	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
2F, 2L	RST 9 Grades 11 – 12	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
2F	RST 8 Grades 9 - 10	Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students will accurately use domain specific words and phrases when describing to clients, and/or instructors/peers, various business procedures, complex technical procedures or advanced technical techniques. • Students will read about and briefly summarize various technical and professional processes using a top down web, 2 column notes, or another relevant graphic organizer. • Students will read technical documents including, but not limited to appraisers reports, in order to write a repair plan and then develop an accurate timeline to determine the length of time needed for a repair. • Students will read and compare appropriate measurements and devices specific to each manufacturer’s recommendations and then perform the technical task according to those instructions. 		
2G, 2K	W 7 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.

2G.02.03	W 8 Grades 9 – 10	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
2G	W 8 Grades 11 – 12	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
2G, 2H	RST 2 Grades 9 – 10	Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
2G, 2L	RST 7 Grades 11 -12	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students will perform a given technical task then write a multi-paragraph essay describing the various choices they made in technical tools and materials, and explaining how those choices brought about success in the task. • Students will research how to perform a specific technical task, and describe the process and industry standards of that task. • Students will read technical texts and websites, as well as view technical videos and simulations specific to welding and cutting metal, and complete open response assessments accurately on the step by step technical procedures. • Students will read and analyze industry specifications and other technical documents to determine an exact process and select the exact materials needed to complete a technical task in the career area. • Using the jigsaw method, students will read a technical text, view an instructional video, or research websites reporting back to the group the right tool to use for a variety of technical tasks, based on specific purposes and planned outcomes of the task. 		
2G	WHST 8 Grades 9 – 10	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
2G	WHST 8 Grades 11 – 12	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
2H	WHST 5 Grades 9 – 10 and 11 – 12	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

2H	WHST 6 Grades 9 -10	Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
2H	WHST 6 Grades 11 – 12	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
2I	RST 8 Grades 6 - 8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students will write a short technical paper explaining why they chose specific tools to complete a career area technical task. • Students will use technology to create a brief word document, flow chart, or technical checklist, and peer edit the process in the related classroom using various technical and writing rubrics. • Students will create a personal research question focusing on a specific welding procedure, research and then answer that question in a multi-paragraph technical report. • Students will revise a piece of technical writing, using a technical procedure and writing rubric, striving to utilize more accurately domain specific words and phrases. • Students will enter various texts into technology to produce clear and understandable documents, peer edit, and then present a more refined final draft document to the class, using a power point presentation. • Students will read and then recall accurate technical information on a variety of tests, quizzes, and short open response questions. 		
2I, 2K	W 2 Grades 9 – 10 (a – f)	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.
2I, 2K	W 2 Grades 11 – 12 (a – f)	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.
2L	RST 8 Grades 11 - 12	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students will complete a variety of open response questions on multistep and complex technical procedures performed in the career area. • Students will complete open response questions using domain specific vocabulary and phrases with accuracy, while describing a variety of complex technical procedures with step by step precision. • Students will read an appraisal in a step by step sequence; students will inspect the vehicle following the backwards design method for task completion, then document that all parts are accurately in place before releasing completed vehicle to the customer. 		

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.C.01, 2.C.03	8.NS.1	Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.

Performance Example:

- Student will measure paint film thickness using appropriate measuring devices. Student will use knowledge of decimal expansion to compare and order measures.

Embedded Science and Technology/Engineering

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.A.01-2.L.06	Chemistry Grades 9-12 Periodicity 3.2	Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students use the periodic table to classify elements. For example, students identify two elements from each of the three classes of elements, metals, nonmetals and metalloids that are found in automobiles and explain the function of each of these elements. 		
2.A.01-2.L.06	Chemistry Grades 9-12 Properties of Matter 1.1	Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.
2.A.01-2.L.06	Chemistry Grades 9-12 Properties of Matter 1.2	Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.
2.A.01-2.L.06	Chemistry Grades 9-12 Properties of Matter 1.3	Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students distinguish between physical and chemical properties and changes. For example, students identify substances that are found in automobiles and explain their physical and chemical properties. • Students classify matter as either pure substances or mixtures. For example, students create a graphic organizer including the terms pure substances, elements, compounds, mixtures, heterogeneous and homogeneous mixtures and add an example found in automobiles to each sub-category of matter. • Students recognize that there are three normal states of matter and can describe phase changes in thermodynamic terms. For example, students identify pure substances found in automobiles that are usually found in either the solid, liquid or gas phase and describe the motion of the atoms or molecules that make up the substance. Students use a table to identify the temperatures at which phase changes occur for each pure substance at one atmosphere pressure (melting/freezing and boiling /condensation temperatures). 		
2.A.01-2.L.06	Chemistry Grades 9-12 States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.5	Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).
2.A.02 2.A.05	Chemistry Grades 9-12 States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.1	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 the combined gas law to determine changes in pressure, volume, and temperature.

2.C.02	Chemistry Grades 9-12 Chemical Reactions and Stoichiometry 5.4	Determine percent compositions, empirical formulas, and molecular formulas.
2.F.01 2.H.03	Chemistry Grades 9-12 Acids and Bases and Oxidation-Reduction Reactions 8.4	Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.
2.G.01-06	Chemistry Grades 9-12 Chemical Reactions and States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.3	Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students recognize that all thermodynamic processes irreversibly dissipate energy which cannot be used as work. For example, students explain limits to engine efficiency as related to irreversible energy transformations to heat. • Students use kinetic molecular theory to explain relationships between the pressure, volume and temperature of an ideal gas. For example, students use kinetic molecular theory to explain pressure and temperature, and prepare four graphs of ideal gas behavior keeping the third parameter constant: Pressure vs. volume, volume vs. temperature, pressure vs. temperature and volume vs. number of moles (number of particles). Students explain each graph. • Given an empirical formula, students calculate percent composition by mass of elements in a compound for example, given the periodic table and the molecular formula for a simple compound; students determine percent composition by mass for each element in the compound. • Students recognize that many common chemical reactions may be classified as redox reactions. For example, students compare and contrast chemical equations for the combustion of acetylene with two chemical equations for metal rusting. • Students describe the properties of gases, liquids and solids in terms of particle motion. For example, students compare the motion of the atoms in the welded area before, during and after the addition of heat energy to the area. 		
2.H.02	Chemistry Grades 9-12 Chemical Reactions and Chemical Bonding 4.6	Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.
2.I.02	Chemistry Grades 9-12 Acids and Bases and Oxidation-Reduction Reactions 8.2	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).
2.K.01	Chemistry Grades 9-12 Solutions, Rates of Reaction, and Equilibrium	Describe the process by which solutes dissolve in solvents.
2.I.03	Chemistry Grades 9-12 Chemical Reactions and Stoichiometry 5.2	Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students name and write chemical formulas for simple compounds. For example, students name common paint components and write out chemical formulas for each using a table. • Students examine a pH scale and use it to categorize the relative strengths of acids and bases. For example, students use a table to identify the pH of battery acid and explain why personal protective equipment (PPE) 		

<p>is required when working with battery acid, but not when working with water.</p> <ul style="list-style-type: none"> Students describe the process of solvation. For example, students compare mixing of hydrophobic-hydrophobic, hydrophilic-hydrophilic and hydrophobic-hydrophilic solutions. Students also qualitatively compare the heats of solution of common substances in water. Students classify chemical reactions by type. For example, students research older and newer refrigerants used in automobiles and, in a short paper, describe the chemistry of refrigerant mediated ozone depletion including classification of one of the chemical reaction steps. Students explain the reasons for special handling of refrigerants, and state a claim regarding the safety of currently used refrigerants. 		
2.K.01	Chemistry Grades 9-12 Solutions, Rates of Reaction, and Equilibrium	Describe the process by which solutes dissolve in solvents.
2.H.01- 2.L.06	Chemistry Grades 9-12 SIS3: Analyze and interpret results of scientific investigations.	Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis.
2.H.01- 2.L.06	Chemistry Grades 9-12 SIS4: Communicate and apply the results of scientific investigations.	<p>Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations.</p> <p>Review information, explain statistical analysis, and summarize data collected and analyzed as the result of an investigation.</p> <p>Explain diagrams and charts that represent relationships of variables.</p> <p>Construct a reasoned argument and respond appropriately to critical comments and questions.</p> <p>Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings.</p> <p>Use and refine scientific models that simulate physical processes or phenomena.</p>
<p>Performance Examples:</p> <ul style="list-style-type: none"> Students describe the process of solvation. For example, students compare mixing of hydrophobic-hydrophobic, hydrophilic-hydrophilic and hydrophobic-hydrophilic solutions. Students also qualitatively compare the heats of solution of common substances in water. Students use the results of their investigations to reach conclusions. For example, students frame their repair plan as a scientific experiment, i.e., identify the problem, write a hypothesis, describe the experiment and reach a conclusion that either supports or refutes their original hypothesis. Students rigorously evaluate, communicate and respond to challenges of the findings of their investigations. For example, students execute their repair plan. They present the process by which they came to their solutions in a logical way and use critical thinking in their response to constructive challenges of their methods and solutions. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.A.01	Physics Grades 9-12 Motions and Forces 1.5	Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.

2.A.02 2.I.03	Physics Grades 9-12 Heat and Heat Transfer 3.3	Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming.
2.A.03	Physics Grades 9-12 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.
2.A.04 2.I.02	Physics Grades 9-12 Electromagnetism 5.5	Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students use collinear force diagrams to determine the net force acting on an object. For example, students draw a scaled force diagram to show the normal and gravitational forces acting between the automotive lift and automobile lift points. • Students recognize that energy is absorbed or released during phase changes and can explain the relationships between phase changes. For example, students use a graphic organizer to show refrigeration steps and explain in terms of kinetic molecular theory why heat is absorbed from surroundings when refrigerant vaporizes, and released to surroundings when refrigerant condenses. • Students explain that energy can produce a separation of charges. For example, students diagram the method by which a hybrid vehicle's rechargeable battery is recharged and describe at least two energy transformations that take place that enable this process. • Students explain voltage as caused by a potential difference and electrical power as the rate at which charge moves through a potential difference. For example, students use Ohm's Law to calculate the internal resistance of a power tool. Students determine the amount of power the tool can produce in watts using $P=IV$ and relate this formula to the definition of power, which is the rate at which work is done. 		
2.B.01	Physics Grades 9-12 Mathematical Skills	Convert within a unit (e.g., centimeters to meters).
2.C.01 2.F.01	Physics Grades 9-12 Mathematical Skills	Measure with accuracy and precision (e.g., length, volume, mass, temperature, time).
2.D.01-03 2.D.07	Physics Grades 9-12 Motions and Forces 1.8	Describe conceptually the forces involved in circular motion.
2.D.04	Physics Grades 9-12 Motions and Forces 1.4	Interpret and apply Newton's three laws of motion.
2.D.09 2.G.02	Physics Grades 9-12 SIS2: Design and conduct scientific investigations.	Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration (if required), technique, maintenance, and storage.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students perform unit conversions. For example, students measure the length of an automobile part in feet and convert to inches and yards. Students measure the same part in decimeters and convert to millimeters, centimeters and meters. Students state a claim for the relative ease of use of either the metric or English systems of measurement. • Students measure with accuracy and precision. For example, students compare the use of high and low precision measuring tools and describe situations in which either high precision or low precision measuring tools are more appropriate. • Students describe forces involved in circular motion. For example, students calculate the magnitude of torque necessary to tighten a bolt given average force applied and the lever arm length. Students explain 		

<p>why a 90° angle between the applied force and the radius of the turning object maximizes torque.</p> <ul style="list-style-type: none"> • Students interpret and apply Newton’s laws of motion. For example, students interpret Newton’s third law by comparing the force of the hammer on metal with the force of the metal on the hammer. Students demonstrate Newton’s third law punch a piece of paper and determine that the paper can’t exert a larger force on their fists than the fist exerts on the paper. • Students properly use, calibrate and maintain investigative materials, equipment and instruments. For example, students use, maintain and store the type of thread cutting tap required. 		
2.E.01	Physics Grades 9-12 Electromagnetism 5.6	Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.
2.G.01 2.G.06	Physics Grades 9-12 Heat and Heat Transfer 3.1	Explain how heat energy is transferred by convection, conduction, and radiation.
2.G.03	Physics Grades 9-12 Electromagnetism 5.2	Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm’s law).
2.G.04 2.G.05 2.H.01-03 2.K.01-03 2.L.01-06	Physics Grades 9-12 SIS2: Design and conduct scientific investigations.	Select required materials, equipment, and conditions for conducting an experiment.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students recognize that the interplay between electric and magnetic forces is the basis for the electric motor. For example, students make a simple electric motor using a battery, magnets, and a coil of copper wire and analyze the motion of the coil. • Students explain three methods of heat transfer. For example, students describe warming of an object by convection, conduction, and radiation. • Students use Ohm’s Law to determine relationships between current, voltage and resistance. For example, given a simple circuit diagram showing a voltage drop and resistors, students calculate the current passing through each resistor. • Students prepare for accomplishing procedures by selecting required materials, equipment and conditions. For example, students prepare for auto body welding by protecting computers and other electronic control modules during welding procedures according to manufacturer’s specifications. 		
2.I.01	Physics Grades 9-12 Conservation of Energy and Momentum 2.3	Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.
2.I.04	Physics Grades 9-12 Conservation of Energy and Momentum 2.5	Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object.
2.J.01 2.K.04	SIS2: Design and conduct scientific investigations.	Write procedures that are clear and replicable.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students describe how work done is equivalent to a change in mechanical energy. For example, students use Pascal’s Law to determine the distance that a small piston will travel resulting from hydraulic pressure caused by a larger piston, and explain the greater distance traveled by the small piston using the work-energy theorem. • Students provide and interpret examples of the conservation of momentum. For example, students defend the use of air bags using the impulse-momentum theorem. • Students write procedures which can be replicated in order to verify results. For example, students write procedures for plastic repair referencing manufacturer’s guidelines. 		

2.K.05	Physics Grades 9-12 SIS1: Make observations, raise questions, and formulate hypotheses.	Observe the world from a scientific perspective.
2.A.01- 2.L.06	Physics Grades 9-12 Conservation of Energy and Momentum 2.1	Interpret and provide examples that illustrate the law of conservation of energy.
<p>Performance Examples:</p> <ul style="list-style-type: none"> • Students observe the world from a scientific perspective. While inspecting an automobile refinishing for paint problems, students identify a potential problem area (make observations) and propose a possible solution to the problem (hypothesize). • Students recognize that energy is conserved in everyday experience. For example, students compare mechanical energy transformations resulting from a car crashing at different speeds to cars of different masses crashing at the same speed. 		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

- Inter-Industry Conference on Auto Collision Repair (I-CAR) Certifications
- Automotive Service Excellence (ASE) Certifications
- Occupational Safety and Health Administration (OSHA) 10 Hour Certification
- Environmental Protection Agency (EPA) 6H Rule Certification
- Safety and Pollution Prevention (SP/2) Certification - Provider: 1 (877) 463-6287

Other

Reference Materials

Auto Body Repair Technology 5th Edition

Collision Repair Fundamentals

Inter-Industry Conference on Auto Collision Repair (I-CAR) Curriculum

Auto Body Repair Technology 5th Edition

By James E.Duffy 2009 Delmar Cengage Learning

ISBN 1-4180-7353-9

Collision Repair Fundamentals 1st Edition

By James E.Duffy and Paul Uhina 2008 Thomson Delmar Learning Clifton Park, NY 12065

ISBN-10 1418013366

I-CAR Training Support Center

5125 Trillium Blvd.

Hoffman Estates, IL 60192

Related National, Regional, and State Organizations

National Automotive Technical Education Foundation (NATEF)

Professional Organizations

Automotive Service Excellence (ASE)

Inter-Industry Conference on Auto Collision Repair (I-CAR)

Student Organizations

SkillsUSA is a partnership of students, teachers and industry working together to ensure America has skilled workforce. SkillsUSA helps each student to excel. SkillsUSA's mission is to help its members become world-class workers, leaders and responsible American citizens. www.skillsusa.org

Selected Websites

www.collisioncareers.org - This site is for those considering a career in collision repair, those who have already chosen a career in collision repair, and those who want to instruct and/or guide students in a career of collision repair. In essence, it is a webpage devoted to serve students, parents, technicians, guidance counselors, instructors, and school administrators.

www.collisioneducationfoundation.org - The Collision Repair Education Foundation's overall goal is to support the pre-employment segment of the collision industry. The Education Foundation's funding focus is on secondary and post-secondary career and technical school and college collision programs and their students. The scholarships and grants distributed enhance the education experience for students by better preparing them to understand the new technology and gain the skills necessary to be a successful collision industry member. Collision repair businesses are then able to hire these well-trained students as productive, efficient, and capable employees from day one on the job.