Massachusetts Department of Elementary & Secondary Education

Office for Career/Vocational Technical Education

Vocational Technical Education Framework

ଌ

Agriculture and Natural Resources Occupational Cluster

Agricultural Mechanics (VAGME)

CIP Code 010201

June 2014

Massachusetts Department of Elementary and Secondary Education
Office for Career/Vocational Technical Education
75 Pleasant Street, Malden, MA 02148-4906
781-338-3910
www.doe.mass.edu/cte/

This document was prepared by the
Massachusetts Department of Elementary and Secondary Education
Mitchell D. Chester, Ed.D.
Commissioner

Massachusetts Department of Elementary and Secondary Education
75 Pleasant Street, Malden, MA 02148-4906
Phone 781-338-3000 TTY: N.E.T. Relay 800-439-2370
www.doe.mass.edu

Table of Contents

Acknowledgements

The Massachusetts Department of Elementary and Secondary Education, Office for Career/ Vocational Technical Education, launched the Vocational Technical Education Framework Revision Project in April 2012. This Framework is the result of that effort and of the contributions of many educators across the state. The Department of Elementary and Secondary Education wishes to thank all of the Massachusetts groups that contributed to the development of these standards and all the individual teachers, administrators, and private sector advisory committee members who provided valuable employer validation of the standards for Agricultural Mechanics Framework of the Agriculture and Natural Resources Occupational Cluster.

Contributors to the 2012 Agricultural Mechanics Framework (VAGME) Strands 2, 3 and 6:

Project Administrator:
Roger Bourgeois, Essex Agricultural and Technical High School
Dr. Christine Shaw, Salem State University

Framework Team Leader:
Stephen P. Dempsey, Bristol County Agricultural High School

Technical Teachers:
David Travers, Smith Vocational Agricultural High School
Shawn Howard, Bristol County Agricultural High School
Brian Boyd, Norfolk County Agricultural High School

Academic Teachers:
Megan Ashton, Bristol County Agricultural High School
Matthew Joyce, Norfolk County Agricultural High School
Terri Ciolfi, Bristol County Agricultural High School

Program Advisory Members:
John Bobala, Bobala Farm and Equipment Repair
Albert Bouchard, Bristol County Agricultural High School (Retired)
Jason Hockman, J. Hockman, Inc.
Mert Howes, Local 8, Heavy Equipment Operator
Robert Lawrence, Robert Lawrence Builders
Jeffery Slater, Patriot Freightliner Western Star, LLC
Joshua Toomey, Westfield Equipment Service

CVTE Frameworks Project Advisory Committee

Roger Bourgeois, Superintendent/Director
Essex Agricultural and Technical High School

Christine Shaw, Executive Director
Northeast Regional Readiness Center

Peter Dewar, Director of Professional Development
Massachusetts Association of Vocational Administrators

John McDonagh, Grants Coordinator
Southeastern Regional Vocational Technical High School

Massachusetts Department of Elementary and Secondary Education
Patricia Gregson, Associate Commissioner
Vocational, Workforce and College Readiness Programs

Office for Career/Vocational and Technical Education – Framework Revision Strands 2, 3 and 6
Lisa Sandler, Acting State Director of Career/Vocational Technical Education

Maura Russell
Ramona Foster
Karen DeCoster
Lisa Weinstein
Margie Roberts
Janice Crocker

Consultants

Dr. Frank Llamas
Maura McMahon

Contributors to the 2014 Agricultural Mechanics Framework (VAGME) Strands 1, 4 and 5:

Project Administrator
Thomas Hickey, Superintendent
South Shore Vocational Technical High School

Project Managers
Rebecca Buck, Northern Berkshire Vocational Regional School District
Kristin Steiner, Northern Berkshire Vocational Regional School District

MAVA Consultants
Kathy Conole Deborah DePaolo John McDonagh

Massachusetts Department of Elementary and Secondary Education
Patricia Gregson, Associate Commissioner
Vocational, Workforce and College Readiness Programs

Office for Career/Vocational and Technical Education – Framework Revision Strands 1, 4 and 5
Lisa Sandler, Massachusetts Methods of Administration Coordinator
Gary Gomes, Accountability & Monitoring Supervisor
Marnie Jain, Education Specialist

Framework Strand 1 Leader:
Michael Nixon, MassBay Community College

Team Members:
Patricia Allen, Greater New Bedford Regional Technical High School
Cheryl Bomal, Greater Lowell Technical High School
Deborah Brightman, Greater New Bedford Regional Technical High School
Martin Dooley, Lower Pioneer Valley Career and Technical Education Center
Darla Hartung, Taunton High School
Rhonda Moran, Lower Pioneer Valley Career and Technical Education Center
John Morash, Plymouth South High School
John Taylor, Greater Lowell Technical High School

Resource Experts:
Anne Gilligan, DESE-Learning Support Service, Safe and Healthy Schools Coordinator
David Edmonds, DESE-CVTE, Education Specialist
Lisa Sandler, DESE-CVTE, Massachusetts Methods of Administration Coordinator

Framework Strand 4 Leader:
Marcia Kessler, Old Colony Regional Vocational Technical High School

Team Members:
Erin Carerra, Taunton High School
Gillian Granger, Blackstone Valley Regional Vocational Technical High School
Carol Hartnett, Blue Hills Regional Technical High School

Christina Melvin, Worcester Technical High School
Cecilia Smith, Greater Lawrence Technical School
EJ Smith, Blackstone Valley Regional Vocational Technical High School
Michael Viggiano, Madison Park High School

Resource Experts:

Gary Gomes, DESE-CVTE, Accountability and Monitoring
Elizabeth Hennessy, Blackstone Valley Regional Vocational Technical High School, Dir. of Counseling
Marnie Jain, DESE-CVTE,
Judith McKinstry, Business Professionals of America Director
Lisa Sandler, DESE – CVTE, Massachusetts Methods of Administration Coordinator
Shailah Stewart, DESE - College & Career Readiness, Connecting Activities Coordinator
Karen Ward, SkillsUSA Director

Framework Strand 5 Leader:

Margaret Ellis, JP Keefe Technical High School

Team Members:

Lori Alie, Blackstone Valley Regional Vocational Technical High School
Lori Carr, Taunton High School
Barbara-jean Chauvin, Norfolk County Agricultural High School
Cheryl Hackenson, Tantasqua Regional High School
Clifford Keirstead, Whittier Regional Technical High School
Lynn McKiernan, Assabet Valley Regional Technical High School
John Oldham, Old Colony Regional Vocational Technical High School
Arlene Thompson, Worcester Technical High School

Resource Experts:

Jennifer Green, Network For Teaching Entrepreneurship Executive Director
Donna McFadden, MA DECA Director
Lisa Sandler, DESE –CVTE, Massachusetts Methods of Administration Coordinator

Massachusetts Department of Elementary and Secondary Education

75 Pleasant Street, Malden, Massachusetts 02148-4906 Telephone: (781) 338-3000
TTY: N.E.T. Relay 1-800-439-2370

Mitchell D. Chester, Ed.D.
Commissioner

July 2014

Dear Colleagues,

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

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

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

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

Sincerely,

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

Introduction

Overview & Organization and Key Changes

Overview

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

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

1. The revision of Strands One, Four, and Five to complete the revision of all six strands of the Vocational Technical Education Frameworks;

2. Statewide Professional Development on all revised strands, with training on strands two, three, and six delivered fall 2013, and training on strands one, four, and five delivered spring 2014;

3. The creation and development of additional Model Curriculum Unit (MCU) Teams.

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

The Office for Career/Vocational Technical Education solicited statewide input from technical and academic teachers and administrators at the annual Massachusetts Association of Vocational Administrators (MAVA)/Massachusetts Vocational Association (MVA) - Connecting for Success Conference. Each framework team met with their content colleagues and reviewed the draft revisions and obtained valuable feedback. Additionally, all drafts were reviewed and revised by the Massachusetts Vocational Technical Teacher Testing Program, to ensure appropriate measurable language.

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

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

The Phase I Process was completed on an accelerated timetable and resulted in all Vocational Technical Education Frameworks; Stand 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

The section contains the following:

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

Highlights of Changes to the Vocational Technical Education Frameworks:

Strand One:

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

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

Strand Two:

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

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

titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

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

Strand Three:

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

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

Strand Four:

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

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

Strand Five:

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

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

Strand Six

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

Appendix[1]

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

The Appendix[2] 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.*
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.

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.

Strand 1: Safety and Health Knowledge and Skills

1.A Fundamentals of Health and Safety

1.A.01 Describe and apply health and safety regulations.

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

1. A.01 Performance Examples:

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

1.A.02 Demonstrate appropriate health and safety practices based on the specific occupational area.

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

1.A.02.06 Locate emergency equipment, first aid kit, SDS information directories and emergency action/response plan/escape routes in your lab, shop and classroom, including labels and signage that follow OSHA Hazard Communication Program (HAZCOM), eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches and emergency exits.

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

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

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

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

1. A.02 Performance Examples:

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

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

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

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

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

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

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

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

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

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

1. A.03 Performance Example:
- Define first aid procedures and protocols used to handle emergency situations and practices used to avoid accidents.
- View safety videos and discuss the role of workplace safety.
- Attend or participate in a human rights alliance organization presentation.
- Observe and/or demonstrate the appropriate use of a fire extinguisher using the (PASS) technique: Pull, Aim, Squeeze, Sweep.
- Review and discuss specific policies, procedures and protocols regarding discrimination, harassment and bullying.
- Discuss and/or role-play proper and respectful behavior that contributes to a positive climate.
- Discuss and/or demonstrate behavior that contributes to a collaborative/teamwork environment.

Selected Websites

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

Strand 2: Technical Knowledge and Skills

2.A Agricultural Mechanics Safety Health Knowledge and Skills

2.A.01 Identify and follow safety practices and procedures according to current industry and OSHA standards.

- 2.A.01.01 Explain the importance of OSHA in providing a safe and healthy workplace for workers.
- 2.A.01.02 Describe appropriate action in case of fire, accident, or other emergency.
- 2.A.01.03 Identify and reduce hazards in the workplace and work environment.
- 2.A.01.04 Select and use personal protective equipment (PPE).

2.A.01 Performance Example:

- Sketch a floor plan of the shop area indicating the location of safety equipment. (e.g., fire blanket, fire extinguisher, eye wash, flammable storage, first aid kit, etc.) Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint.

2.A.02 Follow OSHA precautions associated with the Four High Hazards (falls, electrocution, struck-by (e.g. falling objects, trucks, and cranes) and caught-in or between (e.g. equipment, vehicles, and trench hazards).

- 2.A.02.01 Identify major hazards.
- 2.A.02.02 Describe types of hazards.
- 2.A.02.03 Identify methods of protection from hazards.
- 2.A.02.04 Identify employer requirements to protect workers from hazards.

2.A.02 Performance Example:

- Participate in the 10-hour OSHA training and successfully earn a certificate.

2.A.03 Select and use the appropriate tool to perform a given task.

- 2.A.03.01 Select tools and equipment.
- 2.A.03.02 Use tools and equipment safely, following OSHA guidelines and industry standards.
- 2.A.03.03 Set up, maintain and adjust tools and equipment following manufacturer's operating instructions.
- 2.A.03.04 Store tools according to manufacturer's specifications and industry standards.

2.A.03 Performance Example:

- As part of class and lab participation, each student will be responsible for the maintenance and safe handling of the tools utilized in agricultural mechanics. In preparation for this, students will work as a group to organize the tool storage area including the creation of an instructional handling guide book (flip chart style laminated and on display/easy access in the tool area). Each student (or pair of students) will be responsible for creating a reference page for a given tool. These documents will include writing, editing and revising using correct terminology and proper grammar and writing techniques for informational text.

2.B Agricultural Machinery and Equipment

2.B.01 Operate agricultural equipment including tractors.

- 2.B.01.01 Explain all safety precautions for specific equipment prior to use.

2.B.01.02 Perform pre- and post-trip inspection.
2.B.01.03 Start, stop, and operate a tractor and/or other agricultural equipment.
2.B.01.04 Identify and use common ASAE hand signals to communicate on the job site.

2.B.01 Performance Example:
- Complete assigned reading related to the maintenance, repair and operation of a tractor or piece of equipment. Students will participate in classroom instruction on these topics and complete assignments on each of the components involved in safe operation. Once a student has mastered the individual skills, they will work as a team to perform preventive maintenance service on a tractor or piece of equipment then operate a tractor.

2.B.02 Attach implement(s) to a tractor.
2.B.02.01 Make hitch and PTO adjustments.
2.B.02.02 Establish ballast and tire pressure.
2.B.02.03 Adjust wheel tread spacing.

2.B.02 Performance Example:
- After thorough reading of related text and equipment manual students will attach an implement to a tractor.
- Using the tire manufacturer's and operator's manuals,, the students will set tire pressure to specifications and explain the effects which ambient and tire temperature have on tire pressure.

2.B.03 Prepare equipment for winter storage.
2.B.03.01 Lubricate and clean equipment prior to winter storage.
2.B.03.02 Protect equipment for storage in cold climates (below freezing).

2.B.03 Performance Example:
- Students prepare a piece of equipment for storage following recommended procedure in the operator's manual.

2.B.04 Select fuels, coolants, lubricants and hydraulic fluids for tractors, machinery and equipment.
2.B.04.01 Identify appropriate use of "on and off" fluids.
2.B.04.02 Identify different types of hydraulic oils.
2.B.04.03 Identify different types of motor oils.
2.B.04.04 Identify different types of antifreeze.
2.B.04.05 Identify different gear oils and greases.

2.B.04 Performance Example:
- Students will refer to service and repair manuals to determine the engine's oil capacity and select the correct grade and type needed. (e.g., 15w40 ca for compression-ignition, synthetic etc.).

2.B.05 Identify and replace air induction system components.
2.B.05.01 Identify all parts of an intake system.
2.B.05.02 Service a wet type air filter.
2.B.05.03 Explain function of a turbocharger.
2.B.05.04 Explain function of a charge air cooler.

2.B.05 Performance Example:

- Students identify the parts of a turbocharger in a break down example and explain in writing how the turbocharger operates, including what happens to the combustion air while going through it. Based on observations and background reading, students write a position paper regarding the advantages of cooling the air before it reaches the combustion chamber.

2.B.06 Identify and service cooling system components.

- 2.B.06.01 Identify and explain parts of an air cooled system.
- 2.B.06.02 Identify and explain parts of a liquid cooled system.
- 2.B.06.03 Describe the different types of antifreeze.
- 2.B.06.04 Check and inspect a cooling system.
- 2.B.06.05 Test and set freeze protection.
- 2.B.06.06 Explain the use of diesel coolant additives (DCA).

2.B.06 Performance Example:

- Students develop a presentation on how a liquid cooling system operates. The presentation will include a one page overview with key features of a liquid cooling system, reference dictionary of terms, and visual diagram (or animated media component). The presentation will include a demonstration of how to accurately calculate fluid ratios.

2.B.07 List and explain the function of components in the fuel system.

- 2.B.07.01 Identify types of fuel systems.
- 2.B.07.02 Describe the purpose of and diagram the components of carburetor and fuel injection systems.
- 2.B.07.03 Describe the different types of fuel pumps.

2.B.07 Performance Example:

- When given a parts breakdown, student will identify parts of the carburetor.

2.B.08 Identify and service hydraulic system components.

- 2.B.08.01 Identify major system components.
- 2.B.08.02 Identify types of hydraulic pumps.
- 2.B.08.03 Describe basic hydraulic principle.
- 2.B.08.04 Test, adjust and repair a hydraulic system.

2.B.08 Performance Example:

- Student will make a replacement hydraulic hose for a given piece of hydraulic equipment by measuring the length of hose and determining the diameter needed as well as selecting the appropriate size & type of fittings necessary to complete the assembly.

2.B.09 Demonstrate the operation and service of a transmission and clutch.

- 2.B.09.01 List the functions and types of transmissions.
- 2.B.09.02 Identify different types of clutches.
- 2.B.09.03 Service and adjust a transmission and clutch.

2.B.09 Performance Example:

- When given the service manual for a large tractor or truck, students will adjust the clutch and pedal-free-travel to specifications.

2.B.10 Understand and identify charging, starting, and ignition system components.

- 2.B.10.01 Describe electrical principle.
- 2.B.10.02 Identify types of batteries.
- 2.B.10.03 List the principles of alternators and generators.
- 2.B.10.04 Explain the function of a starter motor.
- 2.B.10.05 Repair an ignition system.
- 2.B.10.06 Diagnose and replace electrical system components.
- 2.B.10.07 Troubleshoot and repair components within an electrical system.

2.B.10 Performance Example:

- Using safety procedures, students will load test a 12 volt battery and determine if it is good to use or needs to be replaced.
- Given the repair manual for a large multi cylinder gasoline engine, students will select the proper tools, determine the firing order, install the distributor correctly in the engine, and set ignition timing to specifications.

2.B.11 Operate gasoline and diesel engines.

- 2.B.11.01 Describe 2 and 4 stroke operating principles.
- 2.B.11.02 List and diagram the major internal parts of gas and diesel engines.
- 2.B.11.03 Select and use measuring tools when replacing or reinstalling parts.
- 2.B.11.04 Select and use hand tools to complete a repair or maintenance task on a gas or diesel engine.
- 2.B.11.05 Disassemble and assemble a (small or large) gas engine.
- 2.B.11.06 Disassemble and assemble a (small or large) diesel engine.
- 2.B.11.07 Diagnose, repair, adjust or replace engine parts.

2.B.11 Performance Example:

- Using the service manual and appropriate tools, students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine.. When given a bore and stroke along with the number of cylinders, students will calculate the engine's displacement.

  Example:
  Bore = 4.00"
  Stroke = 3.48"
  Cylinders = 8

  Displacement = R2 X 3.14 X Stroke X Cylinders
  R2 = 4
  Stroke = 3.48
  Pi = 3.14

  4.00 x 3.14 = 12.56 x 3.48 = 43.7088 Cubic Inch x 8 = 349.67 or 350 Cubic Inch

2.C Construction, Repair, and Maintenance

2.C.01 Perform various basic carpentry tasks associated with the agricultural mechanics field.

- 2.C.01.01 Identify building materials and describe their applications.
- 2.C.01.02 Read and interpret construction blueprints, working drawings, and building codes.
- 2.C.01.03 Estimate needs, costs, and quantity of building materials.
- 2.C.01.04 Perform carpentry math calculations.
- 2.C.01.05 Measure and layout a related carpentry task.
- 2.C.01.06 Store lumber and other carpentry materials for future use.

2.C.01.07 Check structures for square, plumb, and level.
2.C.01.08 Select and install fasteners and hardware as appropriate for the task at hand.
2.C.01.09* Describe lumber grading and marking systems.

2.C.01 Performance Example:

- Assign students, in groups, a project to build a storage unit for agricultural equipment. The student groups will have a selection of three to four different models for a shed (e.g., gambrel, ½ shed, barn). Each group is responsible for creating a supply list, pricing out the materials, and constructing the shed. Students will have a set budget and other constraints provided by the 'customer' (being the teacher). Throughout the project, students will apply measuring, material selection and carpentry skills.

2.C.02 Use hand and power tools commonly utilized in agricultural mechanics.
2.C.02.01 Select the appropriate tool for a task.
2.C.02.02 Use and maintain fastening, clamping, and dismantling tools (e.g., bench clamps, pneumatic nail gun).
2.C.02.03 Use and maintain sawing tools (e.g., circular saw, table saw, reciprocating saw, power miter saw, radial arm saw).
2.C.02.04 Use and maintain drilling and boring tools (e.g., portable drill, drill press).
2.C.02.05 Use and maintain planing, smoothing, and shaping tools (e.g., power sanders, planers, routers, scrapers).
2.C.02.06* Use and maintain levels (e.g., spirit, rotary laser)

2.C.02 Performance Example:

- Following the specifications from the operating materials (and demonstrations) students create a "Circular Saw Procedures Manual" describing the procedures and steps necessary to use a circular saw safely and efficiently. Students will then present their manual to other students who will determine if the manual is sufficient for operation of a circular saw. Based on feedback from the group, the students will edit and revise their manual.
- Independently, each student will build a sawhorse using the skills developed throughout the unit. Sawhorses require angle and strength considerations. The completed sawhorses will be used throughout the course. Students will use saws, fasters (screws/nails) and other required tools.

2.C.03 Demonstrate skills necessary for building construction, repair, and maintenance.
2.C.03.01 Identify structural components of a building.
2.C.03.02 Select materials, layout, and cut structural components of a building.
2.C.03.03 Identify various siding materials and describe their applications.
2.C.03.04 Demonstrate installation methods for siding materials.
2.C.03.05 Identify various roofing materials and describe their applications.
2.C.03.06 Demonstrate installation methods for roofing materials.
2.C.03.07 Identify tools used for concrete work.
2.C.03.08 Determine quantity and cost of concrete.
2.C.03.09 Prepare forms for concrete.
2.C.03.10 Mix, place, finish, and cure concrete.
2.C.03.11 Prepare surfaces for finish application.
2.C.03.12 Apply paint and other finishing materials.
2.C.03.13 Demonstrate use and maintenance of extension and step ladders.
2.C.03.14* Describe various sources of energy, including renewable, and sustainable practices for construction in agricultural mechanics.

2.C.03.15* Identify environmental concerns and methods for reduced impact in construction and design of agricultural construction.
2.C.03.16* Demonstrate use and maintenance of pump-jack staging and wall brackets.
2.C.03.17* Demonstrate use and maintenance of roof brackets.
2.C.03.18* Install windows and exterior doors.
2.C.03.19* Explain the reason for building codes and describe the different types of work governed by each code.
2.C.03.20* Layout and cut rough stairs.
2.C.03.21* Layout and cut a common rafter.
2.C.03.22* Identify various framing methods and terms (e.g. gable, hip, truss, balloon, and platform).
2.C.03.23* Explain code requirements for insulation and vapor barriers.

2.C.03 Performance Example:
- Building upon the project to build a shed; Students will pour a concrete foundation, install the shed, and install roofing material. Considerations regarding snow load and soil consistency will be taken into account. Advanced application would involve creating storage spaces for specific tools and materials utilized in agricultural sciences and mechanical operations.

2.D Metal Work

2.D.01 Perform a variety of welding skills including arc welding, plasma cutting, gas welding, and gas cutting.
2.D.01.01 Select and prepare materials, tools and equipment for welding and cutting based on the task at hand.
2.D.01.02 Identify and follow safety practices used in welding and cutting.
2.D.01.03 Set-up, start up, shutdown and secure welding and cutting equipment.
2.D.01.04 Layout and prepare metal for welding and/or cutting.
2.D.01.05 Control for distortion in arc welding.
2.D.01.06 Weld basic joints using SMAW, GMAW, GTAW and FCAW.
2.D.01.07 Cut mild steel, including pipe.
2.D.01.08* Braze weld basic joints.
2.D.01.09* Weld basic joints out of position (i.e., vertical, horizontal, overhead) using SMAW, GMAW.
2.D.01.10* Select and apply hard surfacing materials/alloys.
2.D.01.11* Read metal working plans, prints, drawings and welding symbols.
2.D.01.12* Estimate and calculate welding and cutting materials costs.

2.D.01 Performance Example:
- After unit lessons on each of the welding techniques and practice sessions to gain both confidence and form, students will repair or assemble a piece of agricultural equipment out of metal. Students may select to create a blade for a trowel or hoe, or repair a loose piece. Once the pieces are completed, members of the advisory board will come in to evaluate the repair/design of the finished metal work. The work will be evaluated on quality of work and effective use of the different welding techniques. Students will include a one page written document on the process they used and why they used the techniques they did, including safety considerations for both the process and the final product.
- The student will demonstrate a step-by-step procedure for the recommended method of checking for leaks in gas welding equipment.
- When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat.
- When given a plan and the appropriate tools and materials, the student will properly cut pipe of mild steel.

2.D.02 Manipulate hot and cold metal.

- 2.D.02.01 Identify various types and shapes of metal.
- 2.D.02.02 Select appropriate materials, tools and equipment for hot and cold metal working.
- 2.D.02.03 Select soldering equipment and supplies.
- 2.D.02.04 Prepare and solder copper joints.
- 2.D.02.05 Prepare and solder electrical connections.
- 2.D.02.06 Join metals with appropriate fasteners.
- 2.D.02.07 Determine tap and drill sizes.
- 2.D.02.08 Layout and drill holes with a twist drill.
- 2.D.02.09 Repair damaged threads.
- 2.D.02.10* Cut threads with taps and dies, to meet given specifications.
- 2.D.02.11* Select appropriate metals for projects (strength).
- 2.D.02.12* Select appropriate abrasives for grinding and sharpening.
- 2.D.02.13* Set-up and prepare grinding and sharpening equipment.
- 2.D.02.14* Recondition chainsaw, horticultural and turf cutting tools.
- 2.D.02.15* Recondition rotary lawn mower blades.

2.D.02 Performance Example:

- After checking the guards on a bench grinder for proper adjustment measurements (tool rest, tongue gauge), the student will safely and appropriately use the bench grinder to recondition a cold chisel without losing its cutting edge temper.
- When given the appropriate tools and materials, the student will safely drill and tap a hole to a 60%, 3/8-16 thread in the center of a 2 ½" x 1 ½" x ¼" thick piece of mild steel.
- The student will use appropriate methods to prepare metal for soldering or brazing by removing oxidation and other impurities allowing for maximum capillary action when welding.

2.E Irrigation Systems

2.E.01 Explain concepts fundamental to irrigation systems.

- 2.E.01.01 Compare and contrast different irrigation systems based on the benefits and costs of the different technologies and methods used.
- 2.E.01.02 Select an irrigation system for a specific climate and need.
- 2.E.01.03 List cost factors involved with irrigation systems for a variety of scenarios and applications.
- 2.E.01.04 Identify the impact that natural occurrences such as erosion, weathering, etc. can have on an irrigation system.
- 2.E.01.05* Summarize the environmental protection regulations that must be considered when developing an irrigation system.

2.E.01 Performance Example:

- Students will choose a land area (yard, athletic field, golf course, etc.) and perform an analysis on that land area where they discuss the pros and cons of 3 different kinds of irrigation systems.

2.E.02 Demonstrate plumbing skills necessary to fabricate/maintain an irrigation system.

- 2.E.02.01 Identify jobs requiring a licensed plumber.
- 2.E.02.02 Describe the different types of pipes and fittings.
- 2.E.02.03 Select appropriate pipe threading and cutting tools based on the irrigation model selected.

2.E.02.04 Cut and assemble plastic pipe to given specifications.
2.E.02.05 Cut and assemble steel pipe to given specifications.
2.E.02.06 Connect flare and compression fittings.
2.E.02.07 Solder copper fittings.

2.E.02 Performance Example:

- Based on a set of specifications, student teams will create a model irrigation system to address the needs of the landscape. Students will build the system and irrigate a sample plot. The plot will then be planted with the product (e.g., grass, flowers, tomatoes, rice, etc.) within the lab and the students will monitor the effectiveness of their irrigation model. This long term project would result in a redesign.

NOTES:

* indicates supplemental/advanced learning standards and objectives.

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	Definition
Chain of Command and Organizational Structure 	Refers to the management structure of an organization. It identifies lines of authority, lines of communication, and reporting relationships. Organizational structure determines how the roles, power and responsibilities are assigned and coordinated and how information flows between the different levels of management. (A visual representation of this structure is called an org chart).
FICA	Federal Insurance Contributions Act requires taxes deducted from pay for supporting Social Security.
Income Statement	A financial statement providing operating results for a specific time period showing a business's revenues, expenses and profit or loss.
Market Research	• Primary: Surveys, Focus Groups, Observation • Secondary: Websites, Internet
Marketing Mix	A set of controlled variables that formulate the strategic position of a product or service in the marketplace. These variables are known as the 4 P's of marketing and include product, place, price and promotion.
Methods to Track Inventory, Productivity and Labor Cost	Refers to the processes a business uses to account for: 1) the inflows and outflows of inventory and materials related to inventory; 2) the efficiency of operations and 3) the cost of labor including salary and benefits.
Promotional Tools and Techniques	The six elements of a promotional mix are: advertising, visual merchandising, public relations, publicity, personal selling and sales promotion.
Supply Chain	The supply chain, or channel of distribution, describes how the product is handled and/or distributed from suppliers with materials, to the manufacturer, wholesaler or retailer and finally to the consumer.
Target Market	Those who are most likely to buy your product or service.

Strand 6: Technology Literacy Knowledge and Skills

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

6.A.01 Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

- 6.A.01.01 Use online help and other support to learn about features of hardware and software, as well as to assess and resolve problems.
- 6.A.01.02 Install and uninstall software; compress and expand files (if the district allows it).
- 6.A.01.03 Explain effective backup and recovery strategies.
- 6.A.01.04 Apply advanced formatting and page layout features when appropriate (e.g., columns, templates, and styles) to improve the appearance of documents and materials.
- 6.A.01.05 Use editing features appropriately (e.g., track changes, insert comments).
- 6.A.01.06 Identify the use of word processing and desktop publishing skills in various careers.
- 6.A.01.07 Identify the use of database skills in various careers.
- 6.A.01.08 Define and use functions of a spreadsheet application (e.g., sort, filter, find).
- 6.A.01.09 Explain how various formatting options are used to convey information in charts or graphs.
- 6.A.01.10 Identify the use of spreadsheet skills in various careers.
- 6.A.01.11 Use search engines and online directories.
- 6.A.01.12 Explain the differences among various search engines and how they rank results.
- 6.A.01.13 Explain and demonstrate effective search strategies for locating and retrieving electronic information (e.g., using syntax and Boolean logic operators).
- 6.A.01.14 Describe good practices for password protection and authentication.

6.A.02 Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

- 6.A.02.01 Demonstrate compliance with the school's Acceptable Use Policy.
- 6.A.02.02 Explain issues related to the responsible use of technology (e.g., privacy, security).
- 6.A.02.03 Explain laws restricting the use of copyrighted materials.
- 6.A.02.04 Identify examples of plagiarism, and discuss the possible consequences of plagiarizing the work of others.

6.A.03 Design and implement a personal learning plan that includes the use of technology to support lifelong learning goals.

- 6.A.03.01 Evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including Web sites.
- 6.A.03.02 Analyze the values and points of view that are presented in media messages.
- 6.A.03.03 Describe devices, applications, and operating system features that offer accessibility for people with disabilities.

6.A.03.04 Evaluate school and work environments in terms of ergonomic practices.

6.A.03.05 Describe and use safe and appropriate practices when participating in online communities (e.g., discussion groups, blogs, social networking sites).

6.A.03.06 Explain and use practices to protect one's personal safety online (e.g., not sharing personal information with strangers, being alert for online predators, reporting suspicious activities).

6.A.03.07 Explain ways individuals can protect their technology systems and information from unethical users.

6.A.04 Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

6.A.04.01 Devise and demonstrate strategies for efficiently collecting and organizing information from electronic sources.

6.A.04.02 Compare, evaluate, and select appropriate electronic resources to locate specific information.

6.A.04.03 Select the most appropriate search engines and directories for specific research tasks.

6.A.04.04 Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, blogs), citing sources.

6.A.04.05 Demonstrate how the use of various techniques and effects (e.g., editing, music, color, rhetorical devices) can be used to convey meaning in media.

6.A.04.06 Use online communication tools to collaborate with peers, community members, and field experts as appropriate (e.g., bulletin boards, discussion forums, listservs, Web conferencing).

6.A.04.07 Plan and implement a collaborative project with students in other classrooms and schools using telecommunications tools (e.g., e-mail, discussion forums, groupware, interactive Web sites, video conferencing).

Appendices

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

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

Embedded Academic Crosswalks

Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
2.A.01.01	RST grades 9-10 #1,4,5	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 4. Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in specific scientific or technical context relevant to grade 9-10 texts and topics. 5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g. force, friction, reaction force, energy).
Performance Example: • Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint.		
2.A.01.01	WHST grades 9-10 #4,10	4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single setting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Performance Example: • Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint.		
2.A.01.03	WHST grades 9-10 #4,5,7,10	4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 5. 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. 7. Conduct short as well as more sustained research projects to answer a 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. 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single setting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Performance Example: • Students will describe, through oral and written presentation, proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources.		
2.A.01.03	SL grades 9-10 #1(a-d)	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.
Performance Example: • Students will describe, through oral and written presentation, proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources.		
2.A.02.02	RST 1,2,3,4,7	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
Performance Example: • Given a power tool and the manufacturer's operator's manual with included diagrams and other visual supports as a reference, the student will determine and verify by making a check list, if all guards and other safety devices are in place and in proper working condition.		
Numerous VTEF standards related	WHST grades 9-10 # 2(a-f), 4,5,9 RST grades 9-10, #3,4	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9. Draw evidence from informational texts to support analysis, reflection, and research. 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Performance Example: • Students will complete a multi step research and writing project on irrigation systems. This will include reading a variety of text focusing on the types and components of irrigation systems, documenting key factors from text, synthesizing the information collected and organizing materials into a written document presenting strategies and considerations for selecting an irrigation system for different types of agricultural or environmental projects (problems). Students will be expected to cite references, edit and revise.		
2.B.02	RST grades 9-10, #3,4	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or

		technical context relevant to grades 9–10 texts and topics.
Performance Examples: • After thorough reading of related text and equipment manual, students will safely and correctly attach an implement to a tractor. • After thorough reading of related text and participating in class instruction/demonstration, students will perform preventive maintenance service on a tractor/ equipment and students will demonstrate the safe operation of a tractor.		
2.B.02.02	RST grades 9-10, #3,7	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
Performance Example: • Students will refer to the tire manufacturer/operator's manual and set tire pressure to specifications and also explain what effect ambient and tire temperature have on tire pressure.		
2.B.03.01	RST grades 9-10, #3	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Performance Example: • For a given piece of equipment, students will follow recommended procedure in the operator's manual to prepare it for storage.		
2.B.05.03- 2.B.05.04	WHST grades 9-10, # 1 (a-e)	1. Write arguments focused on *discipline-specific content*.
Performance Example: • When given a breakdown, students will identify the parts of a turbocharger and also explain in writing, how the turbocharger operates and what happens to the combustion air while going through it. The students will also write a claim to identify the advantages of cooling the air before it reaches the combustion chamber.		
2.B.06.02- 2.B.06.06	WHST grades 9-10 #2a,b,d	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
Performance Example: • Students will explain in writing, using appropriate technical terms, how a liquid cooling system operates. This will include a description of the major components and an explanation of how the liquid can function in extreme cold without freezing and extreme heat without boiling. Given a cooling system's total capacity, students will figure the amount of antifreeze needed for 60% mixture and 40% water for proper freeze protection.		
2.B.09.03	SL grades 9-10, #1a-d, #4	1. 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. 4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
Performance Example: • Students will refer to service manual for proper clutch adjustment procedure, and explain in an oral presentation why it is important to maintain proper adjustment and what the function of the clutch is in the driveline.		
2.B.11 .01- 2.B.11.06	SL grades 9-10, #1 a-d, #4	1. 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. 4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
Performance Example: • Using the service manual students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke along with the number of cylinders, students will calculate the engines displacement.		
2.B.11.01- 2.B.11.06	RST grades 9-10, #3, 4	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
2.B.01.02- 2.B.02.03	SL grades 11-12, #4	4. 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 tasks.
Performance Example: • Using the service manual students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke along with the number of cylinders students will calculate the engines displacement.		
2.C.02.03	WHST grades 9-10 # 2a-f, 4,5,9	2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9. Draw evidence from informational texts to support analysis, reflection, and research.
Performance Example: • Students will be provided with a manufacturer's manual for a particular circular saw. Using the manual, students will create a "Circular Saw Procedures Manual" that will describe and list all the procedures and steps necessary to use a circular saw safely and efficiently.		
2.D.01.04- 2.D.01.06	RST grades 9-10, # 3,4	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Performance Example: • When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat.		
2.D.01.08	RST grades 9-10, #9	9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
2.D.01.08	WHST grades 9-10 #2a,b,d	2. Write informative/explanatory texts, including the narration of

		historical events, scientific procedures/ experiments, or technical processes.

Performance Example:

- Through thorough reading of the text and other representations of the process through media sources or experimentation, students will compare and contrast plasma cutting and gas cutting by creating a list of advantages and disadvantages of each process and use the list to determine the best process to cut a given type of metal.

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.A.02.01-03	5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g. convert 5 cm to 0.05 m) and use these conversions in solving multi-step, real-world problems.
	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.
	G.MG.1	Use geometric shapes, their measures, and their properties to describe objects (e.g. modeling a tree trunk or a human torso as a cylinder).

Performance Example:

- Given that a student's hair becomes caught on a machine's one inch diameter shaft which is rotating at 3,800 rpm's and it takes three seconds of reaction time to turn the machine off. Determine the hair length a student must have to be able to turn off the machine before the hair is completely wrapped-up and ripped out of his/her head.

  3,800 rpm x 3.14"= 11,932 inches of hair per minute
  To convert from inches per min to inches per second multiple by 1 min/60 sec

  11,932 in/min x 1min/60 sec = 198.9 in/sec

  Convert inches per sec to feet per second by multiplying by 1ft/12in
  198.9 in/sec x 1ft/12in = 16.6 ft./sec

  In 3 seconds the length becomes 3sec x 16.6 ft/sec = 49.8ft!!!

2.B.04.03	5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.
	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.

Performance Example:

- Students will refer to service / repair manual to determine the engine's oil capacity. They will determine what grade & type is needed. (e.g. 15w40 ca for compression ignition, synthetic etc.). Given the price of oil per gallon students will calculate how much the cost will be to fill the system and if buying by the gallon how many gallons are needed.

  Example:
  27qts needed to fill system

  1 Gallon = $9.16

Convert quarts to gallons:

$$27qts \times \frac{1gal}{4qts} = 6.75gal$$

6.75 gal x $9.16/gal = $61.83

The cost is $61.83 to buy 27 quarts.

2.B.06.01-06	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.

Performance Example:

- Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection.

  Example:
  10 gallon total capacity
  10 X .60 = 6.0 gallons of antifreeze
  10 gallon total – 6 gallons of antifreeze = 4 gallons of water

2.B.10.01	A-CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Performance Example:

- Students will identify three types of circuits: series, parallel and series parallel. When given voltage, ohms, current or power (watts) students will use Ohm's or Watts Law to find the unknown. Students will explain the proper safety precautions required for servicing, testing, and charging batteries.

  Example:
  I = E/R I = 12volts / 12 Ohms I = 1amp
  R = E/I R = 12volts / 150 amps R = .08 ohms
  E = I X R E = 150 amps X .08 ohms E = 12volts
  Using Ohm's Law, V=IR, determine the resistance (R) of the starting motor circuit if the vehicle has a 12-volt battery and the starting motor draws 150 amperes of current.

  Since our known values are voltage and current, we want to solve for resistance. Solve the formula V=IR for R

  Divide both sides by I

$$\frac{V}{I} = R$$

$$R = \frac{V}{I} = \frac{12volts}{150amps} = .08ohms$$

  The large battery cables and heavy starter windings provide little resistance to the current.

  (p. 526 Diesel Fundamentals Principles and Service Dales and Thiessen 1982)

2.B.11.01	G.MG.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
	G-GMD.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Performance Example:

- Using the service manual, students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs & Stratton OHV engine. Students will also explain the basic engine performance terms & formulas such as bore, stroke, compression ratio, horsepower & torque. When given a bore and stroke along with the number of cylinders students will calculate the engine's displacement.
- Calculating the displacement of an engine is exactly the same as finding the volume of a cylinder. You find the area of the circle inside the cylinder and multiply it by the height of the cylinder. (Remember that the area of a circle is pi times the radius squared.)

Volume = pi x radius squared x height

The volume of all the cylinders is equal, so to get total displacement, we multiply the volume of one cylinder by the number of cylinders.

When given a bore and stroke along with the number of cylinders students will calculate the engine's displacement.

Example: Bore = 4.00" Stroke = 3.48" Cylinders = 8

Diameter is the bore , so radius is half the bore or r = 2in Stroke is height so h = 3.48 in Use 3.14 for pi

Displacement is volume

V = pi x r2 x h

= 3.14 x 22 x 3.48

= 43.7088 cubic inches per cylinder

8 cylinders 8 x 43.7088 = 349.67 cubic inches or about 350 cubic inches

2.C.01.03-2.C.01.04	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.

Performance Example:

- Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g., plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather materials and appropriate tools and construct the sawhorse according to the plans.

Example:

The Bill of Materials list includes;

4 pieces of lumber at ¾"x3¾"x24"

2 pieces of lumber at ¾"x3¾"x14¾"

2 pieces of lumber at ¾"x3¾"x9"

You have some leftover lumber - 1 piece at ¾"x3¾"x 10' and 1 piece at ¾"x3¾"x15"

Do you have enough on hand for this project?

To solve you need to determine the total length needed for ¾"x3¾"

4(24") + 2(14¾") + 2(9") =

96" + 29 ½ " + 18" =

143 ½ " is total amount needed.

Currently on hand is 10' or 120" and 15" for a total of 135"

You could use the 10' board to cut the 4 – 24" pieces and the 2 – 9" pieces and the 15" piece for one of the 14¾" pieces. You need at least another 15" for this project.

2.C.01.07	8.G.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Performance Example:

- Students will be given a piece of plywood measuring 7'x9'. Using the Pythagorean Theorem, students will have to calculate the length of the diagonal for their piece of plywood. Students will then use this information to check if their piece of plywood is truly square.

a2 + b2 = c2
72 + 92 = c2
49 + 81 =130
c2 = 130
Square root of c2 = c
c= square root of 130 is about 11.4 feet
If the diagonal measures 11.4 ft or about 11 feet and 4 13/16 inches it is truly square.

2.C.03.02	G-CO.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

Performance Example:

- When given a set of plans, students will be able to construct a basic structure (dog house, shed, etc.) and apply siding and roofing materials. Prior to construction, students will use the plans to calculate the total area of the walls and roof in order to estimate materials.

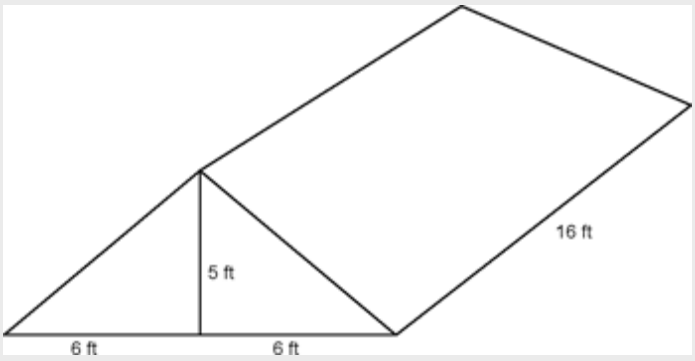
Example:

- After laying out the rectangular building to be sure the four corners are square, measure the distance diagonally from corner to corner. If all four corners are square, the diagonals will be equal in length.

2C.03.06	8.G.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
	7.G.6	Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Performance Example:

- When given a set of plans, students will be able to construct a basic structure (dog house, shed, etc.) and apply siding and roofing materials. Prior to construction, students will use the plans to calculate the total area of the walls and roof in order to estimate materials.



Calculate the area of roof material in square feet, required for the structure shown in the above figure.

Roofing material would be needed for the long rectangular sides. The formula for the area of a rectangle is length x width. We are given the length (16 ft) to find the width we will use Pythagorean Theorem.

a2 + b2 = c2

62 + 52 = c2

36 + 25 =61

c2 = 61

Square root of c2 = c

c= square root of 61 is about 7.8 feet

Area one side of roof = b x h = 16 x 7.8 = 124.8 sq ft

Area of both sides of the roof 2 x 124.8 = 249.6 sq ft

2.C.03.08	G-GMD.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
	5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.

Performance Example:

- Students will be given a plan for a concrete block that they are to produce. From these plans, students will have to figure out the size of the form that they need to build in order to produce the correct size concrete block. Once students have figured out the size that their form needs to be, they will create a working drawing of their form. Once a working drawing of their form is created they will calculate the quantity and cost of the materials needed to construct their form. Students will then gather their materials, construct their forms, and check their forms for square. Once the form is constructed, the students will estimate concrete needs by using formulas for volume and converting answers into cubic yards. Following the manufacturer's instructions, students will then mix concrete, pour it into their form and follow appropriate finishing methods.
- Student will construct a concrete form. The student will then mix concrete, pour it into their form, and finish the concrete.

Example:

You need to order concrete for completing eighty footers. You must determine the quantity and cost for the order. The footers will have a diameter of 12 inches and a depth of 36 inches. You must calculate the volume for one footer and the multiply by 8. When ordering, add an extra 10% to your total.

Volume formula for a cylinder Volume = pi times radius squared times height

V = 3.14 x 6 x6 x 36 (radius is half the diameter)

V = 4096.44 inches cubed

Volume for 80 footings 80(4096.44) = 327715.2 inches cubed

10% of volume .1(327715.2)= 32771.52 inches cubed

327715.2 in cubed + 32771.52 in cubed = 360486.72 in cubed

To order convert to yards cubed.

$$360486.72 \text{ in cubed x } \frac{1\text{ft cubed}}{1728 \text{ in cubed}} x \frac{1\text{yd cubed}}{27 \text{ ft cubed}}$$

= 7.73 cubic yards

You must order to the closest half yard so round up to 8 cubic yards. Concrete costs $125/cubic yard delivered.

8 cubic yards x $125/cubic yard = $1000.		
2.D.01.04- 2.D.01.06	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.
Performance Example: • When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat. Example: To safely use a welding machine, the operator must be aware of the duty cycle for the machine he/she is using. A welding machine with a 60% duty cycle can operate at rated amperage for ____ minutes out of every 10 minutes without overheating. Change 60% to the decimal .6, and then multiply by the time of 10 minutes. .6 x 10 min = 6 minute. The welder can operate the machine for 6 minutes out of every 10 minutes.		
2.D.01.08	5.NF .2	Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.
Performance Example: • When given a plan and the appropriate tools and materials, the student will properly cut pipe of mild steel. Example: Your boss needs you to cut a length of pipe 3 ¾ 'long from an eight foot length, how much will you have left? 8 – 3 ¾ = 4 ¼ You will have 4 ¼ feet of pipe left for your next project.		
2.E.02	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational number.
Performance Example: • Students will be provided with a plan for a PVC pipe loop. From the plan students will determine the total quantity of pipe, the type and quantity of pipe fittings, necessary cleaners and primers, and appropriate tools. Students will then cut the PVC pipes to the correct lengths and assemble them according to the plans. From the plan, it is determined a total of 144 feet of 2 inch PVC pipe will be needed. The pipe is sold in 20 foot lengths. What is the minimum number of 20 ft. lengths that must be purchased? 144 ft./20ft. = 7.2 since you cannot buy partial lengths, round up to 8. You would need to purchase 8 20 ft. lengths of PVC pipe.		

Embedded Science and Technology/Engineering

Earth and Space Science

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Earth and Space Science Learning Standard
2.C.14	2. Energy Resources in the Earth System 2.1	Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, and biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy).
	2. Energy Resources in the Earth System 2.2	Describe the effects on the environment and on the carbon cycle of using both renewable and nonrenewable sources of energy.
Performance Example: • During the units on construction in agricultural mechanics, students will pair up, each conducting research on a different renewable energy source. Each group will propose a renewable energy application for agricultural mechanics construction. Students will prepare and deliver a presentation on their idea to the class.(example: students present a model for a roof top thermal solar power set up for the shed to heat water for clean up. Provided students have time, they can construct the thermal solar panel using piping, painting and construction skills.		
2.E.01.04	3. Earth Processes and Cycles 3.1	Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments, and creates various types of landscapes. Give examples that show the effects of physical and chemical weathering on the environment.
Performance Example: • Based on a set of specifications, student teams will create a model irrigation system to address the needs of the landscape, including weathering and erosion aspects of the environment. Students build a model system and irrigate a sample plot. The plot will then be planted with the product (e.g., grass, flowers, tomatoes, rice, etc.) within the lab and the students will monitor the effectiveness of their irrigation model. This long term project would result in a redesign.		
2.E.01.05	3. Earth Processes and Cycles 3.4	Explain how water flows into and through a watershed. Explain the roles of aquifers, wells, porosity, permeability, water table, and runoff.
	3. Earth Processes and Cycles 3.5	Describe the processes of the hydrologic cycle, including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.
Performance Example: • Using the model irrigation systems students develop in the previous exercise (or as part of a larger class wide project) students conduct water flow tests to determine the water cycle impacting their systems. Ground pitch, elevation, temperature and other natural occurring events are graphed. Students then discuss how human alterations to the land (wells, runoffs, etc.) impact the landscape.		

Life Science (Biology)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Biology Learning Standard
2A.01.02 2A.01.03 2A.01.04	1. The Chemistry of Life 1.1	Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, and S.
	1. The Chemistry of Life 1.2	Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids,

		proteins, nucleic acids).
	1. The Chemistry of Life 1.3	Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature that have an effect on enzymes.
Performance Example: • As part of the preparation to work within the agricultural industry, students will research and develop presentations to share with the class on biological hazards and appropriate safety measures to protect workers in the field. Students will include a basic introduction of biological organism composition, how these are structured and how temperature (climate), environmental conditions (pH, water/soil) impact living organisms. These presentations will provide a context for understanding the fundamental biological concepts related to the agricultural industry. Presentations will include multimedia tools.		
2.B.08	SIS1. Make observations, raise questions, and formulate hypotheses.	Observe the world from a scientific perspective. Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge. Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.
Performance Example: • In preparation for the service of hydraulic systems, students will engage in a series of experiments dramatizing the functions of the system as a whole. This preparation will include the reading and summarizing of trade articles on hydraulic system components.		
2.B.06	SIS2. Design and conduct scientific investigations.	Articulate and explain the major concepts being investigated and the purpose of an investigation. Select required materials, equipment, and conditions for conducting an experiment. Identify independent and dependent variables. Write procedures that are clear and replicable. Employ appropriate methods for accurately and consistently o making observations o making and recording measurements at appropriate levels of precision o collecting data or evidence in an organized way Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, and computers) including set-up, calibration (if required), technique, maintenance, and storage. Follow safety guidelines.
Performance Example: • After unit lessons on each of the welding techniques and practice sessions to gain both confidence and form, students will repair or assemble a piece of agricultural equipment out of metal. Students may select to create a blade for a trowel or hoe, or repair a loose piece. Once the pieces are completed, members of the advisory board will come in to evaluate the repair/design of the finished metal work. The work will be evaluated on quality of work and effective use of the different welding techniques. Students will include a one page written document on the process they used and why they used the techniques they did, including safety considerations for both the process and the final product. • The student will demonstrate a step-by-step procedure for the recommended method of checking for leaks in gas welding equipment. • When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat.		

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.A.01	5. Chemical Reactions and Stoichiometry 5.2	Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.
Performance Example: • Students will describe proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources.		
2.B02	6. 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.
Performance Example: • Students will refer to the tire manufacturer/operator's manual and set tire pressure to specifications and also explain what effect ambient and tire temperature have on tire pressure.		
2.B.05	6. 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.
Performance Example: • When given breakdown, students will identify the parts of a turbocharger and also explain how it operates and what happens to the combustion air while going thru the turbocharger and the advantages of cooling it before it reaches the combustion chamber.		
2.B.06	7. Solutions, Rates of Reaction, and Equilibrium	Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).
Performance Example: • Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity, students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection. Example: 10 gallon total capacity 10 X .60 = 6.0 gallons of antifreeze 10 gallon total – 6 gallons of antifreeze = 4 gallons of water		
2.D.01	3. Periodicity 3.3	Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.
Performance Example: • The student will name eight gases which are commonly used in the welding industry and classify them as either a fuel gas or a shielding gas. (acetylene, argon, propane, nitrogen, helium, CO2, natural gas, propylene, etc.)		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.A.02	1. Motion and Forces 1.8	Describe conceptually the forces involved in circular motion.
Performance Example: • Given that a student's hair becomes caught on a machine's one inch diameter shaft which is rotating at 3,800 rpm's and it takes three seconds of reaction time to turn the machine off. Determine the hair length a student must have to be able to turn off the machine before the hair is completely wrapped-up and ripped out of his/her head.		
2.B.10	5. Electromagnetism 5.2	Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
2.B.10	5. Electromagnetism 5.3	Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
Performance Example: • Students will identify three types of circuits: series, parallel and series parallel. When given voltage, ohms, current or power (watts) students will use Ohm's or Watts Law to find the unknown. Students will explain the proper safety precautions required for servicing, testing, and charging batteries. Example: I = E/R I = 12volts / 12 Ohms I = 1amp R = E/I R = 12volts / 150 amps R = .08 ohms E = I X R E = 150 amps X .08 ohms E = 12volts		

Technology/Engineering

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Technology/Engineering Learning Standard
2.A.02.02	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • Given a power tool and the manufacturer's operator's manual as a reference, the student will determine and verify by making a check list, if all guards and other safety devices are in place and in proper working condition.		
2.A.02	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • Determine the needed hair length for a student to be able to safely turn off equipment after his/her hair has become caught on a rotating part. (1" shaft rotating at 3800 rpm's w/student reaction time of 3 sec.) • Students will refer to service manual for proper clutch adjustment procedure, and explain in an oral presentation why it is important to maintain proper adjustment and what the function of the clutch is in the driveline.		
2.B.06	4. Energy and Power Technologies—Thermal Systems 4.1	Differentiate among conduction, convection, and radiation in a thermal system (e.g. heating and cooling a house, cooking).

Performance Example: • Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity, students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection. Example: 10 gallon total capacity 10 X .60 =6.0 gallons 10 gallon total – 6 gallons of antifreeze = 4 gallons of water		
2.B.11	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • Using the service manual and appropriate tools, students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke along with the number of cylinders students will calculate the engine's displacement. Example: Bore = 4.00" Stroke = 3.48" Cylinders = 8 Displacement = R2 x 3.14 x stroke x cylinders R2 = 4.00 Stroke = 3.48 Pi = 3.14 4.00 x 3.14 = 12.56 x 3.48 = 43.7088 Cubic Inch x 8 = 349.67 or 350 Cubic Inch		
2.C.02	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g., plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather the materials and tools they need, and construct the sawhorse according to the plans.		
2.C.01	1. Engineering Design 1.5	Interpret plans, diagrams, and working drawings in the construction of prototypes or models.
Performance Example: • Students will be given a plan for a concrete block that they are to produce. From these plans, students will have to figure out the size of the form that they need to build in order to produce the correct size concrete block. Once students have figured out the size that their form needs to be, they will create a working drawing of their form. Once a working drawing of their form is created they will calculate the quantity and cost of the materials needed to construct their form. Students will then gather their materials, construct their forms, and check their forms for square. Once the form is constructed, the students will estimate concrete needs by using formulas for volume and converting answers into cubic yards. Following the manufacturer's instructions, students will then mix concrete, pour it into their form and follow appropriate finishing methods.		
2.C.02	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select		

	the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g. plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather materials, and tools they need and construct the sawhorse according to the plans.	
2.D.02.07- 2.D.02.09	2. Construction Technologies 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: • When given the appropriate tools and materials, the student will safely and properly drill and tap a hole to a 60%, 3/8-16 thread in the center of a 2 ½" x 1 ½" x ¼" thick piece of mild steel.		
2.E.01	3. Energy and Power Technologies—Fluid Systems 3.1	Explain the basic differences between open fluid systems (e.g. irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).
Performance Example: • Students will choose a land area (yard, athletic field, golf course, etc.) and perform an analysis on that land area where they discuss the pros and cons of three different kinds of irrigation systems.		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

10-Hour OSHA General Industry Card/Credential*
OSHA General Industry Training Guidelines

10-hour Construction Industry Card/Credential*
OSHA Construction Industry Training Guidelines

CPR & First Aid Training Card/Credential*
American Heart Association and American Red Cross

Massachusetts Hoisting License
Massachusetts Executive Office of Public Safety and Security

Massachusetts Commercial Driver's License
Massachusetts Department of Motor Vehicles

Outdoor Power Equipment Technician Certifications*
Two Stroke Engines, Four Stroke Engines, Compact Diesel Engines, Equipment Electrical Systems
Equipment Engine Training Council (EETC)

Certified Welder
American Welding Society (AWS)

Certified Welding Fabricator
American Welding Society (AWS)

National Institute for Automotive Service Excellence (ASE)
ASE Certifications

*Can be earned by student prior to graduation.

Other

Reference Materials

- Herren, R. & Cooper, P. (2002) Agricultural mechanics: fundamentals and applications. (4 ed). Delmar Thompson Learning.
- Hoerner, T. & Bear, W. & Ahrens, D. (1992) Small gasoline engines: operation, repair & maintenance. Hobar Publications.
- Hoerner, T. & Bettis, M. (1998). Power tool safety and operation small engines. Hobar Publications.
- Hull, D. & Silletto, T. (1996) Safe operation of agricultural equipment: student manual. Hobar Publications.
- The Ohio State University and National Safety Council Penn State University. (2006). National safe tractor and machinery operation program student manual. Hobar Publications.
- Roth, A. (2008). Small gas engines. Goodheart-Wilcox Publications
- Schuster, W. (1995). Outdoor power equipment electrical systems. Tech Horizon Publications

Student Organizations

- Skills USA www.maskillsusa.org