



Vocational Technical Education Framework



Agriculture and Natural Resources Occupational Cluster

Environmental Science and Technology (VENVR)

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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

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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



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Contributors to the 2012 Environmental Science and Technology Framework (VENVR) Strands 2, 3 and 6:

Project Administrator:

Roger Bourgeois, Essex Agricultural and Technical High School

Framework Team Leader:

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

Technical Teachers:

Russell Anderson, Worcester Technical High School; Larry Carlesi, Greater New Bedford Regional Vocational Technical High School; Tabitha Hobbs, Southeastern Regional Vocational Technical School; Chris Pires, Greater New Bedford Regional Vocational Technical High School; Terence Regan, Minuteman High School; Dr. Dhimitri Skende, Worcester Technical High School; Ann Witzig, Essex Agricultural and Technical High School; Brian Bastarache, Bristol County Agricultural School; Aaron Caswell, Bristol County Agricultural School; Lee McMillan, Essex Agricultural and Technical High School

Academic Teachers:

Melissa Dalphin, Essex Agricultural and Technical High School; Tabitha Hobbs, Southeastern Regional Vocational Technical School; Larry Carlesi, Greater New Bedford Regional Vocational Technical High School; Chris Pires, Greater New Bedford Regional Vocational Technical High School; Dr. Dhimitri Skende, Worcester Technical High School

Program Advisory Members:

Michael Armstrong, MA Division of Fisheries and Wildlife; Dr. Joe Buttner, Salem State University; Ray Faucher, MA Department of Conservation and Recreation; Katherine Foley, Stantec, Inc.; Mike Kastanotis, Weston and Sampson; Jennifer Pederson, MA Water Works Association; Joseph Perry, MA Department of Conservation and Recreation; Ellie Horwitz, MA Division of Fisheries and Wildlife (Retired); Anthony Wilbur, Minuteman High School; Adam Stackhouse, Essex Agricultural and Technical High School

CVTE Frameworks Project Advisory Committee

Roger Bourgeois, Superintendent/Director Essex Agricultural and Technical High School	Peter Dewar, Director of Professional Development Massachusetts Association of Vocational Administrators
Christine Shaw, Executive Director Northeast Regional Readiness Center	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 Environmental Science and Technology Framework (VENVR) 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

Commissioner's Letter



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; Strand Two and Strand Six, revised with current, rigorous, relevant standards. Strand Three has been redesigned into a crosswalk which directly correlates academic and technical standards. An appendix of useful material for technical teachers recommended by their peers was added to each framework.

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

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

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

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

The Strand Four Team revised the Employability Knowledge and Skills that all students need to acquire. Teams considered current research on career readiness, including the work of the College Career Readiness Task Force convened by the Department, changes in workplace, technological changes that impact how people perform their work (i.e., communications methods), and included standards that

emphasize the need for lifelong learning and adaptability given the multiple career changes over and an individual's working life. The team recommended this strand be renamed to: Career Readiness.

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

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

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

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

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

Organization and Key Changes

This section contains the following:

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

Highlights of Changes to the Vocational Technical Education Frameworks:

Strand One:

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

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

Strand Two:

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

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

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

Strand Three:

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

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

Strand Four:

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

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

Strand Five:

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

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

Strand Six

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

Appendix¹

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

The Appendix² contains:

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

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

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Organization of the Frameworks – Strand Two

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

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

2.A Automotive Technology Specific Safety Practices

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

2.A.01 Performance Example:

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

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

2.A.02 Performance Example:

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

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

2.A.03 Performance Example:

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

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

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

Advanced / Supplemental Standards (Not Required)

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

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

Advanced Automotive Technology Technical Knowledge and Skills

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

2.CC Demonstrate appropriate engine repair techniques.

2.CC.01 Perform appropriate cylinder Head Repair.

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

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

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

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

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

2.B.04 Performance Examples:

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

Agriculture and Natural Resources Occupational Cluster

Environmental Science and Technology Framework (VENVR)

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 Environmental Science Safety Health Knowledge and Skills

- 2.A.01 Identify the need for and demonstrate the ability to perform CPR & First Aid as applied to the industry.
 - 2.A.01.01 Demonstrate effective CPR as outlined by the American Heart Association.
 - 2.A.01.02 Demonstrate the first aid skills outlined by the American Heart association for basic first aid.

- 2.A.01 Performance Example:
- Attain a CPR/First Aid Training Card/Credential.

2.B Environmental Systems

- 2.B.01 Explain concepts fundamental to Environmental Systems and society.
 - 2.B.01.01 Define the major goals of Environmental Science.
 - 2.B.01.02 Identify the major fields of study in the Environmental Sciences (e.g. biology, ecology, botany, forestry, earth science, physics, chemistry, and social science).
 - 2.B.01.03 Distinguish among the roles of conservation, preservation and multiple use management practices.
 - 2.B.01.04 Differentiate between renewable and non-renewable resources.
 - 2.B.01.05 Explain the importance and role of biodiversity.
 - 2.B.01.06 Define sustainability as it relates to the economy, environment and society (e.g. sustainable agriculture, aquaculture, environmental justice, and environmental ethics).
 - 2.B.01.07 Explain the relationship between public health policy/politics and the environment.
 - 2.B.01.08 Describe and assess the impact of invasive species on local ecosystems.
 - 2.B.01.09 Evaluate greenhouse effect and potential long-term impacts on global climate change and resulting environmental impact.
 - 2.B.01.10 Identify potential career paths in the various fields of Environmental Science.

- 2.B.01 Performance Example:
- Students conduct a field visit to a site (e.g. TOTOR, DCR, Local Land Trust) and perform the following:
 - Investigate and identify the organization's goals.
 - Identify what impact the site owner's activities have on the local and global environment.
 - Identify areas of study that would benefit someone managing the site.
 - Develop a brief example of short and long term management plans to sustain and improve the property. The students are asked to focus on areas of concern and suggest an Action Plan to manage the issue.

- 2.B.02 Explain concepts fundamental to the Hydrosphere.
 - 2.B.02.01 Identify and describe the water cycle.
 - 2.B.02.02 Diagram the connection between ground water and surface water.
 - 2.B.02.03 Define an aquifer and elaborate on its ecological role.
 - 2.B.02.04 Describe global water use and distribution.
 - 2.B.02.05 Define water conservation and recommend implementation strategies.
 - 2.B.02.06 Differentiate between point source vs. non-point source pollution.
 - 2.B.02.07 Distinguish categories and sources of water pollution.

2.B.02 Performance Example:

- Diagram the flow of storm water throughout the school property while paying attention to where the water comes from and where it is being discharged. Identify areas where school activities may add to the pollution of the water as it flows through the campus. Compare and debate your findings with your peers and propose steps to improve storm water management.

2.B.03 Explain concepts fundamental to the Atmosphere.

2.B.03.01 Identify major sources of air pollution. (e.g. hydrocarbon, Chlorofluorocarbon (CFC), Sulfur dioxide (SO₂)).

2.B.03.02 Define acid rain, identify major sources, diagram how it travels, and elaborate on its impact.

2.B.03.03 Describe ozone depletion, identify major sources, and assess potential impact.

2.B.03.04 Differentiate between weather and climate and the factors which affect them.

2.B.03.05 Explain how the tilt of the earth and its rotation around the sun affects seasons and climate.

2.B.03.06 Identify and diagram the primary layers of the atmosphere.

2.B.03.07 Distinguish heat transfer mechanisms (conduction, convection, radiation, and latent heating).

2.B.03 Performance Example:

- Students conduct research and create a presentation explaining the main concepts relevant to the atmosphere including the following:
 - Air Quality and Airborne Particulates
 - Acid Rain
 - Ozone Depletion
 - Weather and Climate
 - Atmosphere Layers
 - Heat Transfer

2.B.04 Explain concepts fundamental to the Geosphere.

2.B.04.01 Identify the three major rock types and diagram the rock cycle.

2.B.04.02 Explain how glaciers shaped the Massachusetts landscape and identify related landforms.

2.B.04.03 Describe the concepts behind plate tectonics and continental drift theories.

2.B.04.04 Explain how extreme heat, fluids, and direct pressures affect surface and subsurface rocks.

2.B.04 Performance Example:

- Use local data on surficial and bedrock geology to identify local rocks and areas that have been influenced by glacial and post glacial activity. Students retrieve field samples of local rocks and identify the type of rock and mineral composition. Students provide a history on the formation and the changes their sample may have undergone over geologic time.

2.B.05 Explain concepts fundamental to the Biosphere.

2.B.05.01 Identify and describe biotic and abiotic factors.

2.B.05.02 Define and explain the scientific principles of natural selection and evolution.

2.B.05.03 Differentiate between evolution and adaptation.

- 2.B.05 Performance Example:
- Students conduct an ecosystem study on campus.
 - Survey the area of land and determine the biotic and abiotic features.
 - Identify the dominant biotic factors and how they have adapted to that ecosystem.
 - Predict future changes in the ecosystem and how the biotic factors might change.

2.C Natural Resource Management

- 2.C.01 Explain concepts fundamental to Aquatic Ecosystems.
- 2.C.01.01 Differentiate between various types of fresh water ecosystems (e.g. rivers, streams, lakes, and ponds).
 - 2.C.01.02 Differentiate between various types of salt water ecosystems (e.g. estuaries, tide pools, brackish water, and salt marshes).
 - 2.C.01.03 Define a watershed.
 - 2.C.01.04 Illustrate and discuss pond succession.
 - 2.C.01.05 Differentiate between natural and cultural eutrophication.
 - 2.C.01.06 Diagram thermal stratification of a lake and elaborate on seasonal turnovers.
 - 2.C.01.07 Collect aquatic organisms for study using appropriate equipment (e.g. Plankton Tows, D-Nets, Kick Seine).
 - 2.C.01.08 Identify common aquatic organisms using field guides.
 - 2.C.01.09 Identify common wetland types and elaborate on wetland functions (e.g. vernal pools, swamps, and bogs).

- 2.C.01 Performance Example:
- Conduct an aquatic ecosystem study which evaluates the status of two or more ecosystems found in your watershed. This study should include:
 - Describing where these ecosystems occur in your watershed.
 - Identifying the characteristics of the ecosystems being studied.
 - Utilizing the appropriate field equipment for the ecosystems selected.
 - Keeping a log of species found.

- 2.C.02 Explain concepts fundamental to Meteorology.
- 2.C.02.01 Identify the basic types of clouds and their associated weather patterns.
 - 2.C.02.02 Interpret a weather map.
 - 2.C.02.03 Analyze the role of the ocean on weather and climate.
 - 2.C.02.04 Gather meteorological data using a variety of techniques. (e.g. temperature, barometric pressure, humidity, wind speed, Beaufort scale conversion, wind chill, cloud type, and cloud cover percentage).
 - 2.C.02.05 Gather and document air quality data (e.g. acid rain, particulates).

- 2.C.02 Performance Example:
- Conduct a weather study over the course of a few weeks or more. The study should include cloud types and meteorological data.

- 2.C.03 Demonstrate practices fundamental to Soil Science.
- 2.C.03.01 Identify basic soil particle sizes (e.g. sand, silt, clay, loam).
 - 2.C.03.02 Diagram the soil horizons for a given site.
 - 2.C.03.03 Conduct soil tests for pH, N, P, and K.
 - 2.C.03.04 Describe factors that lead to soil erosion and determine soil conservation practices.
 - 2.C.03.05 Utilize a given soil classification system (such as USDA or Unified Soil Classification System) for a given study site.
 - 2.C.03.06 Explain the role of drainage class, porosity and permeability in the storage and transport of water.

2.C.03.07 Conduct a sieve analysis of a soil sample.

2.C.03 Performance Example:

- Conduct an analysis of a soil profile including:
 - Diagram of the layers and their associated depths.
 - Determine the soil texture of each layer.
 - Conduct a nutrient analysis of the A layer.
 - Identify the drainage class.
 - Estimate porosity and permeability.

2.C.04 Demonstrate practices related to Wildlife Biology.

- 2.C.04.01 Define and cite examples of producers, consumers and decomposers in an ecosystem.
- 2.C.04.02 Distinguish between species as herbivores, carnivores or omnivores.
- 2.C.04.03 Diagram a food web for a local ecosystem.
- 2.C.04.04 Study wildlife populations using a variety of methods. (e.g. quadrat, line transect, mark recapture).
- 2.C.04.05 Summarize federal, state, and local wildlife regulations.
- 2.C.04.06 Describe types of evidence for the presence of common wildlife species.
- 2.C.04.07 Identify common New England wildlife species using field guides.
- 2.C.04.08 Describe the role of the federal and state Endangered Species Act in protecting wildlife.

2.C.04 Performance Example:

- Create a detailed trophic food web for a Massachusetts ecosystem. Be sure to include
 - Federally listed species
 - State listed species
 - Identify 5 species seen in the field
- Use field surveys to assess local habitat and then create a management plan for a state or federally listed species found in/near your area. Include both habitat requirements and your species role in the food web.

2.C.05 Demonstrate practices related to Forestry.

- 2.C.05.01 Identify common New England trees using a dichotomous key.
- 2.C.05.02 Define and diagram forest stratification and life zones.
- 2.C.05.03 Diagram and describe primary and secondary forest succession.
- 2.C.05.04 Measure the height and diameter of a tree and calculate the total board feet.
- 2.C.05.05 Measure the basal area of a tree.
- 2.C.05.06 Explain the interactions between the local forest community and associated wildlife species.

2.C.05 Performance example:

- Conduct a survey of a local forest. This should include:
 - Analyze the percent and diversity of various life zones (e.g. canopy, understory, shrub, and ground cover).
 - Identify the stage of succession.
 - Determine average tree height.
 - Determine average diameter at breast height (i.e. 4 ½ feet).
 - List tree species present and their associated abundance.

2.D Mapping and Geospatial Analysis

2.D.01 Navigate local terrain using industry practices and techniques.

- 2.D.01.01 Describe the technology of data acquisition through remote sensing.
- 2.D.01.02 Interpret topographic maps.

- 2.D.01.03 Utilize map coordinate systems.
- 2.D.01.04 Utilize a compass.
- 2.D.01.05 Utilize a Global Positioning System (GPS) Unit.

2. D.01 Performance Example:

- Navigate to an assigned destination by drawing a compass bearing on a topographic map, setting the bearing correctly, and following the compass bearing to the identified location on the topographic map.
- Create a compass bearing to an unfamiliar location and on a different topographic map.

- 2.D.02 Utilize technologies and resources associated with effective land use planning.
 - 2.D.02.01 Create a base map using data such as aerial images, conservation lands, farm land, open space, areas of critical environmental concern (ACEC's), and vernal pools.
 - 2.D.02.02 Determine and set the scale for the base map of a study area.
 - 2.D.02.03 Import GPS waypoints into Geographic Information Systems (GIS) database from field studies.
 - 2.D.02.04 Conduct natural resource inventories in forests, inland waters, and marine environments.
 - 2.D.02.05 Propose best management practices for local areas (e.g. ecosystem management, watershed management, and storm water management).
 - 2.D.02.06 Evaluate the role of conservation commissions and laws in town land use planning.

2. D.02 Performance Example:

- Assess the effect of land use practices in the local watershed on river water quality including the following:
 - Determine local land use patterns in their watershed from Mass GIS data layers.
 - Design and carry out the field data collection of river water quality.
 - Analyze the data using geospatial mapping tools.

Concentration: Environmental Technology

2.E Environmental Technology Safety Health Knowledge and Skills

- 2.E.01 Complete the training for the 40-Hour OSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) certificate.
 - 2.E.01.01 Complete the requirements of OSHA HAZWOPER Regulations Standard 29 CFR 1910.120 for General Industry and/or 29 CFR 1926.65 for the Construction Industry.

2.E.01 Performance Example:

- Attain an OSHA HAZWOPPER certificate.

- 2.E.02 Complete the training for a Permit-Required Confined Space certificate.
 - 2.E.02.01 Complete the requirements for the OSHA Permit-Required Confined Spaces Regulations Standard 29 CFR 1910.146 for General Industry.

2.E.02 Performance Example:

- Attain a Permit-Required Confined Space certificate.

2.F Environmental Sampling & Laboratory Services

- 2.F.01 Conduct environmental field sampling.
 - 2.F.01.01 Keep records using field notebooks.
 - 2.F.01.02 Use, maintain and calibrate environmental sampling meters (e.g. pH, DO, specific conductivity, PID).

- 2.F.01.03 Collect and transport representative samples.
- 2.F.01.04 Perform preservation techniques and list materials required for specific sampling activities.
- 2.F.01.05 Prepare and follow Standard Operating Procedures.
- 2.F.01.06 Create a simulated Chain of Custody.
- 2.F.01.07 Sample using QA/QC procedures (e.g. replicates, equipment blanks and trip blanks).
- 2.F.01.08 Decontaminate equipment and tools used during sampling.
- 2.F.01.09 Test water quality using field test kits and assess water quality results.

2.F.01 Performance Example:

- Conduct environmental field tests using a variety of field test kits and equipment (e.g. water, soil, forestry, air) along with completing the proper paperwork and demonstrate specific Standard Operating Procedures (SOP) for each given test.

2.F.02 Conduct environmental laboratory analysis.

- 2.F.02.01 Implement laboratory record keeping techniques for specific situations according to current industry standards.
- 2.F.02.02 Conduct microbiological testing (e.g. total coliform, fecal coliform).
- 2.F.02.03 Use, maintain and calibrate environmental bench top sampling meters (e.g. pH, DO, specific conductivity, and spectrophotometers).
- 2.F.02.04 Measure, contain, and mix substances using common laboratory equipment (e.g. balances, pipettes, volumetric flasks).
- 2.F.02.05 Prepare solutions of a specific concentration by diluting solutions of known concentrations.

2.F.02 Performance Example:

- Conduct environmental laboratory analyses and tests using common laboratory equipment (e.g. balances, pipette, volumetric flask, water quality test kits, etc.).

2.G Energy Technologies and Sustainability

2.G.01 Measure energy efficiency and explain its role in reducing air, water, and soil pollution.

- 2.G.01.01 Project energy saved through recycling a material and compare to pollution created without recycling.
- 2.G.01.02 Identify major sources of CO₂ emissions.
- 2.G.01.03 Explain the benefits and costs of alternative energy sources that produce electricity (e.g. geothermal, nuclear, photovoltaic, wind, and biomass).
- 2.G.01.04 Assess the advantages and disadvantages of alternative fuels.
- 2.G.01.05 Specify the attributes of a Leadership in Energy and Environmental Design (LEED) certified building.
- 2.G.01.06 Diagram electricity distribution from plant production to end use (e.g. solar, coal, nuclear).
- 2.G.01.07 Utilize a variety of tools to measure energy use and assess energy use impact (e.g. Kill-A-Watt meter, light meter, hygrometer, online calculators, etc.).

2.G.01 Performance Example

- Perform a full exterior and interior energy audit of a building.
 - Perform a room-to-room inspection with an infrared camera to pinpoint air leakage.
 - Determine if the home is equipped with properly installed and working smoke and CO-detectors.
 - Identify any potential fire hazards within the building.
 - Conduct a blower door test to calculate the air leakage.
 - Prepare a detailed air leakage analysis and home improvement plan.

2.H Environmental Site Management

- 2.H.01 Demonstrate practices related to hazardous-waste site assessment and remediation.
- 2.H.01.01 Conduct site reconnaissance and identify conditions indicative of releases or threatened releases of oil or hazardous materials to the environment, such as stained soil, stressed vegetation, or evidence of underground storage tanks.
 - 2.H.01.02 Identify and apply Federal and State hazardous-waste site cleanup regulations (e.g. Massachusetts Contingency Plan (MCP) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)).
 - 2.H.01.03 Identify common sources of soil and groundwater contamination.
 - 2.H.01.04 Identify common classes of chemicals of concern (petroleum products, chlorinated solvents, Volatile Organic Compounds (VOCs), Polychlorinated Biphenyls (PCBs), metals).
 - 2.H.01.05 Describe drilling and sampling techniques used during environmental site assessments.
 - 2.H.01.06 Determine up-gradient, down-gradient, and background conditions at a hazardous-waste site and determine appropriate sampling locations.
 - 2.H.01.07 Conduct a jar-headspace test.
 - 2.H.01.08 Conduct a field permeability test or bail-down test.
 - 2.H.01.09 Measure depth to groundwater in an observation well using an electronic water-level meter and weighted steel tape and chalk.
 - 2.H.01.10 Measure depth to oil and depth to groundwater using an oil-water interface probe.
 - 2.H.01.11 Convert depth to groundwater measurements to groundwater elevations.
 - 2.H.01.12 Create a map of the water table using groundwater-elevation measurements.
 - 2.H.01.13 Determine hydraulic gradient based on maps of the water table.
 - 2.H.01.14 Calculate groundwater velocity using permeability and hydraulic gradient data.
 - 2.H.01.15 Evaluate factors affecting fate, transport and remediation of chemicals in groundwater.
 - 2.H.01.16 Identify and recommend common soil and groundwater remediation systems given chemical and hydrogeologic setting.
 - 2.H.01.17 Interpret process and instrumentation diagrams (P&ID).
 - 2.H.01.18 Prepare a technical report from field data.

2.H.01 Performance Example:

- Conduct an Environmental Site Assessment (ESA) on a parcel of land in general accordance with the American Society of Testing and Materials (ASTM) guideline for Phase I Environmental Site Assessments E 1527-05 (ASTM, 2005). The Assessment will consist of the four main components of an ASTM ESA, including:
 - Review relevant and available federal, state, and local records;
 - Conduct site reconnaissance and observing relevant environmental conditions;
 - Interview someone knowledgeable about the site history; and
 - Prepare a technical report on the findings of the assessment.

2.H.02 Demonstrate practices related to solid waste management.

- 2.H.02.01 Summarize federal and state laws governing waste management and landfill operations.

- 2.H.02.02 Identify the advantages and disadvantages of various solid-waste disposal options
- 2.H.02.03 Recommend strategies for conserving natural resources and virgin materials by proactively promoting recycling technologies and techniques.

2.H.02 Performance Example:

- Identify the major techniques currently used for solid-waste management, including source reduction, reuse and recycling, composting, landfilling, and waste-to-energy and describe the advantages and disadvantages of each technology.
- Draw a diagram of a modern engineered landfill, including natural and artificial liners and caps, drainage layers and leachate-collection systems, gas collection and disposition, and nuisance odor and debris controls.

2.I Applied Water Technologies

2.I.01 Demonstrate practices related to Municipal Wastewater Treatment.

- 2.I.01.01 Explain the purpose and importance of wastewater treatment relative to public health.
- 2.I.01.02 Identify the sources of municipal wastewater and describe the importance of industrial pretreatment.
- 2.I.01.03 Describe the processes in a typical municipal wastewater treatment facility (e.g. preliminary, primary, secondary, advanced or tertiary, disinfection, and de-chlorination).
- 2.I.01.04 Describe and demonstrate the procedures for wastewater sample collection (e.g. fecal coliform, Dissolved Oxygen (DO), Biochemical Oxygen Demand, (BOD), Total Suspended Solids (TSS), settleable solids, pH, and chlorine).
- 2.I.01.05 Conduct laboratory procedures relating to wastewater treatment (e.g. coliform, DO, BOD, TSS, settleable solids, pH, and chlorine).
- 2.I.01.06 Explain local, state, and federal regulations relating to municipal wastewater treatment (e.g. Clean Water Act, NPDES Permit, 314 CMR, 310 CMR).
- 2.I.01.07 Identify career opportunities in wastewater treatment occupations and related credentials.
- 2.I.01.08* Identify the parts, functions and applications of pumps, valves, and other fluid-movement components of a wastewater-treatment plant.
- 2.I.01.09* Perform calculations used in municipal wastewater treatment (e.g. detention time, chemical dosage, % efficiency, flow, velocity, and water pressure).
- 2.I.01.10* Demonstrate proper operation and maintenance of mechanical equipment in a wastewater plant.
- 2.I.01.11* Calculate the loading requirements for chemical dosing based on flow and concentration.
- 2.I.01.12* Identify the most common chemicals used for coagulation, pH adjustment, disinfection, and de-chlorination, in typical treatment processes

2.I.01 Performance Example:

- Identify the major components and functions of a modern municipal wastewater treatment facility, and construct a process-flow diagram of a typical municipal wastewater treatment facility, including:
 - Preliminary treatment (grit and debris removal);
 - Primary treatment (solids removal);
 - Secondary treatment (aeration, activated sludge management, & biological treatment);
 - Advanced or tertiary treatment (e.g. nutrient removal);
 - Disinfection (chlorination, U/V or ozone treatment); and
 - Dechlorination/final treatment (e.g. meeting NPDES discharge limits).

- 2.1.02 Demonstrate practices related to Drinking Water Treatment.
- 2.1.02.01 Describe the purpose and importance of drinking-water treatment.
 - 2.1.02.02 Identify sources of drinking water in Massachusetts and elaborate on the importance of water-supply protection (e.g. ground water and surface water).
 - 2.1.02.03 Describe the processes used in a typical drinking water treatment facility (e.g. coagulation, flocculation, filtration, taste & odor control, disinfection, and fluoridation).
 - 2.1.02.04 Conduct water sampling and collection (e.g. microbiological, lead, copper, organics, radiological).
 - 2.1.02.05 Conduct laboratory procedures related to drinking water analysis and treatment (e.g. turbidity, chlorine, ammonia, iron, manganese, taste/odor, and algae/bacteria).
 - 2.1.02.06 Explain local, state, and federal regulations related to public water supplies (e.g. Safe Drinking Water Act, Public Notification Rule, Surface Water Treatment Rule, Lead & Copper Rule, Total Coliform Rule, Disinfectants and Disinfection Byproducts Rule, Consumer Confidence Reports, 236 CMR, 310 CMR, and M.G.L. Chapter 111, S. 160).
 - 2.1.02.07 Identify career opportunities in drinking water occupations and related credentials.
 - 2.1.02.08* Define a public water supply system, and the regulatory requirements and administrative responsibilities of a public water supply provider.
 - 2.1.02.09* Identify the parts, functions, and applications of pumps, valves, and other fluid-movement components of a drinking-water treatment plant.
 - 2.1.02.10* Demonstrate proper operation and maintenance of mechanical equipment in a drinking-water plant.
 - 2.1.02.11* Compare and contrast the differences among the physical, chemical, and biological properties of groundwater vs. surface water sources.
 - 2.1.02.12* Calculate the loading requirements for chemical dosings based on flow and concentration.
 - 2.1.02.13* Perform safety and security measures related to protection of public drinking-water supplies.
 - 2.1.02.14* Identify the most common chemicals used for coagulation, pH adjustment, disinfection, fluoridation, in typical treatment processes.
 - 2.1.02.15* Perform the calculations used in drinking water treatment (e.g. calculate volume, detention time, chemical dosage, chlorine residual, %efficiency, flow rate, velocity, and water pressure).

2.1.0.2 Performance Example:

- Identify the major components and functions of a modern drinking-water treatment facility, and construct a process-flow diagram of a typical drinking-water treatment facility, including:
 - Surface and groundwater sources;
 - Intake structures;
 - Coagulation;
 - Flocculation and sedimentation;
 - Rapid and slow filtration methods;
 - Taste, odor, and secondary contaminant control;
 - Disinfection and residual disinfection;
 - Fluoridation;
 - Distribution and storage.

NOTES:

* Indicates supplemental/advanced learning standards and objectives.

Supplemental learning objectives and standards may also be taken from the Natural Resource Management Concentration.

Concentration: Natural Resource Management

2.J Safety Health Knowledge and Skills

- 2.J.01 Use outdoor equipment associated with the industry.
 - 2.J.01.01 Set up/adjust at least one type of tent.
 - 2.J.01.02 Describe important points in selecting and fitting a backpack.
 - 2.J.01.03 Light a pack stove and boil 2 cups of water using safe fire practices.
 - 2.J.01.04 Tie six common knots (e.g. bowline, taughtline, sheetbend, clovehitch, cleathitch, timberhitch).
 - 2.J.01.05 Maintain and store equipment following manufacturers' recommendations and industry standards.

2.J.01 Performance Example

- Students will prepare for an extended overnight camping trip by performing the following
 - Unpack and set up a tent.
 - Choose and fit a backpack.
 - Use appropriate knots to attach equipment to a vehicle.

- 2.J.02 Demonstrate concepts fundamental to outdoor safety.
 - 2.J.02.01 Identify weather-related dangers.
 - 2.J.02.02 Identify hazards as they relate to terrain.
 - 2.J.02.03 Identify poisonous and dangerous plants and animals.
 - 2.J.02.04 Identify hazardous situations at the work location.
 - 2.J.02.05 Demonstrate hazard mitigation techniques.
 - 2.J.02.06 Dress properly for a variety of working/weather conditions.

2.J.02 Performance Example:

- Perform a site safety assessment at a local public property (e.g. TTOR, DCR, Local Land Trust) identifying:
 - Poisonous plants
 - Potentially hazardous terrain/objects
 - Possible mitigation practices to improve public safety

- 2.J.03 Demonstrate skills fundamental to water safety.
 - 2.J.03.01 Describe issues related to safety around water.
 - 2.J.03.02 Use waders.
 - 2.J.03.03 Complete Massachusetts Boaters Safety Course.
 - 2.J.03.04 Demonstrate the safe use of kayaks and canoes.

2.J.03 Performance Example:

- Attain Massachusetts Boater's Safety Certification

2.K Conservation Policy and Public Outreach

- 2.K.01* Demonstrate an understanding of research principles.
 - 2.K.01.01* Collect data concerning resource status.
 - 2.K.01.02* Explain the importance of standard data collection and effort.
 - 2.K.01.03* Maintain databases of resource data.
 - 2.K.01.04* Calculate measures of central tendency.

- 2.K.01.05* Describe the relationships between minimal sample size, standard deviation and probability.
- 2.K.01.06* Explain the importance of statistical significance.
- 2.K.01.07* Explain the importance of a random sample.
- 2.K.01.08* Differentiate between a scientific paper and a lay article.
- 2.K.01.09* Identify the components of a scientific paper and the purposes of each.
- 2.K.01.10* Demonstrate proper citation.

2.K.01 Performance Example:

- Students conduct a scientific research project on a topic of their choosing where they will:
 - Design an experiment or question.
 - Collect and analyze relevant data.
 - Write a scientific report utilizing proper APA Style.
 - Give an oral presentation to the class on their project.

2.K.02 Demonstrate an understanding of Natural Resource Policy and Administration.

- 2.K.02.01 Explain the concept of multiple-use management.
- 2.K.02.02 Identify government agencies involved in inland fisheries management.
- 2.K.02.03 Identify government agencies involved in marine fisheries management.
- 2.K.02.04 Identify government agencies involved in forestry management and explain their role.
- 2.K.02.05 Identify government agencies involved in outdoor recreation management and explain their role.
- 2.K.02.06 Identify government agencies involved in wildlife management and explain their role.
- 2.K.02.07 Describe the role of municipal conservation commissions.
- 2.K.02.08 Define a Non-Governmental Organization (NGO), identify examples, and explain their role.

2.K.02 Performance Example:

- Construct a flow chart diagramming the various local, State and Federal agencies responsible for the management of a particular species or resource.

2.K.03 Describe practices related to outdoor public safety.

- 2.K.03.01 Demonstrate recreation area safety enhancement techniques.
- 2.K.03.02 Identify impacts by humans on natural resources.
- 2.K.03.03 Conduct resource inventory and population studies.
- 2.K.03.04 Demonstrate appropriate techniques and use of equipment when working with bio-hazards according to current industry and OSHA standards..
- 2.K.03.05 Describe law enforcement procedures used to manage public gatherings and to gain entry into secure, closed or restricted areas.
- 2.K.03.06 Describe precautions to use when interfacing with the public concerning regulations and law enforcement.
- 2.K.03.07 Describe security issues for closed and restricted areas.
- 2.K.03.08 Describe solutions to issues concerning public protection.
- 2.K.03.09 Identify appropriate law enforcement authorities relating to natural resources spaces.
- 2.K.03.10 Explain how public recreation use is a product.

2.K.03 Performance Example:

- Perform a site safety assessment at a local public property (e.g. TTOR, DCR, Local Land Trust) identifying:
 - Poisonous plants
 - Potentially hazardous terrain/objects
 - Possible mitigation practices to improve public safety

2.K.04 Complete the Certified Interpretive Guide (CIG) training course offered by the National Association of Interpretation (NAI).

2.K.04 Performance Example:

- Earn the Certified Interpretive Guide (CIG) certification offered by the National Association of Interpretation (NAI).

2.L Environmental Sampling & Laboratory Services

2.L.01 Conduct environmental field sampling.

2.L.01.01 Keep records using field notebooks; then transcribe to electronic form.

2.L.01.02 Use, maintain, and calibrate environmental sampling meters (e.g. pH, DO, specific conductivity, PID).

2.L.01.03 Collect and transport representative samples using industry procedures and safety precautions.

2.L.01.04 Demonstrate correct preservation techniques and materials required for specific sampling activities.

2.L.01.05 Prepare and follow Standard Operating Procedures.

2.L.01 Performance Example:

- Collect and record a series of relevant water quality measurements at a given site in the field and create a graph to display possible trends.

2.L.02 Conduct environmental laboratory analysis.

2.L.02.01 Record laboratory practices using industry and scientific record keeping procedures and practices.

2.L.02 Performance Example:

- Conduct a laboratory inventory and keep accurate records regarding use and replacement.

2.M Ecology

2.M.01 Explain concepts fundamental to ecological cycles.

2.M.01.01 Diagram the nitrogen cycle.

2.M.01.02 Describe the carbon cycle.

2.M.01.03 Diagram a trophic pyramid.

2.M.01.04 Compare and contrast symbiotic relationships (e.g. mutualism, commensalism, parasitism, predation, parasitoidism).

2.M.01 Performance Example:

- Diagram a trophic pyramid for a given ecosystem identifying symbiotic relationships that exist.

2.M.02 Demonstrate an understanding of population dynamics.

2.M.02.01 Describe population dynamics.

2.M.02.02 Describe predator-prey relationships.

2.M.02.03 Explain the relationship between harvest levels and resource sustainability.

2.M.02.04 Distinguish between populations, communities and ecosystems.

2.M.02.05 Conduct an estimate of a wild population.

2.M.02 Performance Example:

- Conduct a local deer population estimate utilizing deer droppings as a population index.

2.M.03 Explain concepts and practices related to invasive species management.

2.M.03.01 Identify common and potentially invasive species.

2.M.03.02 Distinguish between introduced and invasive species.

2.M.03.03 Identify damage due to invasive insects, plants, and other organisms.

- 2.M.03.04 Treat for invasive species infestation, using substitutions where appropriate.
- 2.M.03.05 Describe how to report observance of infestations.
- 2.M.03.06 Measure, mix, and apply a recommended chemical for control of a specific pest (e.g. using simulations where appropriate).
- 2.M.03.07 Discuss the pros, cons, and procedures of integrated pest management.
- 2.M.03.08 Identify and manually remove invasive plants using recommended procedures.
- 2.M.03.09 Clean spray equipment after use according to approved practices.
- 2.M.03.10 List state pesticide regulations and protections under the federal worker protection act.

2.M.03 Performance Example:

- Control local areas of invasive species infestation:
 - Identify invasive species.
 - Develop a plan to control/remove invasive species.
 - Control and/or remove invasive species where appropriate.

2.N Wildlife & Fisheries Biology

- 2.N.01 Demonstrate techniques related to wildlife management.
 - 2.N.01.01 Demonstrate wildlife habitat enhancement techniques.
 - 2.N.01.02 Describe wildlife harvest techniques and procedures.
 - 2.N.01.03 Distinguish between commercial, subsistence, and recreational use and their relationship to wildlife management.
 - 2.N.01.04 Use Radio Telemetry with and without triangulation.
 - 2.N.01.05 Use a variety of measuring devices (digital balance, spring scale, calipers etc.).
 - 2.N.01.06 Demonstrate the safe capture and handling of a variety of species utilizing different tools.

2.N.01 Performance Example:

- Utilize a radio telemetry receiver to triangulate the position of a transmitter randomly placed in the field.

- 2.N.02 Demonstrate an understanding of fisheries biology.
 - 2.N.02.01 Identify fish species common to New England.
 - 2.N.02.02 Define fisheries and differentiate consumptive and non-consumptive uses (commercial, subsistence, and recreational).
 - 2.N.02.03 Compare fishery management strategies with consumptive and non-consumptive uses.
 - 2.N.02.04 Classify fish by reproductive strategies. (e.g. levels of parental care, r and K selection, diadromy).

2.N.02 Performance Example:

- Classify and identify various local fish species (both live and preserved specimens):
 - Utilize field guides.
 - Classify by life cycle.
 - Classify by reproductive strategy.

- 2.N.03 Demonstrate fisheries management techniques.
 - 2.N.03.01 Demonstrate stream/pond enhancement techniques.
 - 2.N.03.02 Describe fish harvest techniques and procedures.
 - 2.N.03.03 Measure specimens using a fish board.

- 2.N.03.04 Use a haul seine.
- 2.N.03.05 Explain the use of a backpack and boat mounted electroshocking equipment for fisheries surveys.
- 2.N.03.06 Describe the five most common methods of commercial fishing.

2.N.03 Performance Example:

- Using a fish board accurately measure and record the length of a variety of fish species.

- 2.N.04* Demonstrate an understanding of concepts fundamental to aquaculture.
 - 2.N.04.01* List six occupations in aquaculture.
 - 2.N.04.02* Explain how species requirements will affect aquaculture system design and management.
 - 2.N.04.03* Distinguish between recirculating, flow-through and open systems.
 - 2.N.04.04* Explain the fundamentals of filtration and biofiltration.
 - 2.N.04.05* Define polyculture and give an example.
 - 2.N.04.06* Explain how the nitrogen cycle affects the water quality of a closed system.

2.N.04 Performance Example:

- Design an appropriate aquaculture system for a given species including:
 - Types and levels of filtration.
 - Classify as a recycling, flow-through or open system.

- 2.N.05* Demonstrate practices fundamental to aquaculture.
 - 2.N.05.01* Perform all required water quality tests and explain the significance of the results.
 - 2.N.05.02* Outline sound fish health management practices.
 - 2.N.05.03* Clean and maintain a filter system.
 - 2.N.05.04* Prepare a saltwater solution.
 - 2.N.05.05* Perform routine maintenance and water changes.
 - 2.N.05.06* Identify three types of food and/or feeding preferences.

2.N.05 Performance Example:

- Accurately prepare salt water solutions for both brackish and marine species.

2.0 Forest Conservation

- 2.0.01 Demonstrate an understanding of Botany.
 - 2.0.01.01 Define and explain the relationship between respiration, transpiration and photosynthesis.
 - 2.0.01.02 Define and explain nutrition and fertilization.
 - 2.0.01.03 Identify and describe plant anatomy.
 - 2.0.01.04 Distinguish between sexual and asexual plant reproduction.
 - 2.0.01.05 Describe the effects of soil structure and texture on plant anatomy and physiology.
 - 2.0.01.06 Distinguish monocots from dicots.
 - 2.0.01.07 Distinguish angiosperms from gymnosperms.
 - 2.0.01.08 List the rules for plant nomenclature.

2.0.01 Performance Example:

- Correctly diagram the major anatomical features of a plant and identify their significance.

- 2.0.02 Identify a variety of plants common to the New England region.
 - 2.0.02.01 Give common and scientific names for plants.
 - 2.0.02.02 Demonstrate the use of a key or reference guide to identify plants.

- 2.0.02.03 Identify woody and herbaceous plant species common to a geographical region.
- 2.0.02.04 Identify plants used as habitat indicators (wetlands, uplands, sand plain etc.).

- 2.0.02 Performance Example:
- Prepare a plant sample collection of both woody and herbaceous plants:
 - Identify using field guides.
 - Label with both common and scientific names.
 - Preserve each specimen.

- 2.0.03 Explain concepts and demonstrate techniques fundamental to Forestry
 - 2.0.03.01 Use a chainsaw following manufacturers' and industry safety procedures.
 - 2.0.03.02 Maintain a chainsaw.
 - 2.0.03.03 Explain the use of different forestry equipment (e.g. skidder, tree sheer).
 - 2.0.03.04 Determine forest stand improvement techniques appropriate for a given site.
 - 2.0.03.05 Describe forest harvest techniques and procedures.
 - 2.0.03.06 Identify techniques and equipment needed to prevent wildfire.
 - 2.0.03.07 Follow personal fire prevention precautions while working in natural environments.
- 2.0.04* Define concepts fundamental to wetlands delineation and protection.
 - 2.0.04.01* List and explain the characteristics of wetland plants.
 - 2.0.04.02* List and explain the five wetland species indicator categories and identify common species of each.
 - 2.0.04.03* Compare and contrast submergent, emergent and floating vegetation.
 - 2.0.04.04* Diagram a wetland including litoral, limnetic, and aphotic zones.
 - 2.0.04.05* Delineate a wetland including the vegetative buffer zone.

- 2.0.04 Performance Example:
- Complete the vernal pool certification procedures for Massachusetts:
 - Collect required evidence (e.g. obligate and facultative species).
 - Locate and identify on a map.
 - Complete the Vernal pool observation form.

2.P* Marine Science

- 2.P.01* Demonstrate an understanding of Physical Oceanography.
 - 2.P.01.01* Identify the major ocean basins.
 - 2.P.01.02* Define the characteristics of sea water and its effects.
 - 2.P.01.03* Diagram the environmental conditions associated with the supratidal, intertidal, and subtidal zones.
 - 2.P.01.04* Describe and diagram the zonation of a rocky shore community.
 - 2.P.01.05* Identify the characteristics of an estuary and explain its importance.
 - 2.P.01.06* Explain the relationship between ocean currents and global climate.
 - 2.P.01.07* Predict the tidal amplitude for a given date, time and location using a tide chart.

- 2.P.01 Performance Example:
- Plan a trip to a local beach:
 - Utilize local plant communities to delineate different parts of a beach.
 - Analyze local tide charts to plan for the maximum availability of the intertidal zone.
 - Identify features of the area (e.g. tidal pools, wrack-line).

- 2.P.02* Demonstrate an understanding of Marine Biology.
- 2.P.02.01* Diagram a marine food chain from primary producer through tertiary consumer.
 - 2.P.02.02* Describe the two most important factors that determine where coral reefs develop.
 - 2.P.02.03* Identify common marine reptiles, birds and mammals.
 - 2.P.02.04* Compare and contrast the productivity differences between polar, tropical, and temperate waters.
 - 2.P.02.05* Describe the features of the following ecosystems: estuarine, coral reefs, sandy beach, and rocky shore.
 - 2.P.02.06* Identify common marine invertebrates.
 - 2.P.02.07* Identify common marine producers.
 - 2.P.02.08* Describe the current status of the fisheries industry locally, nationally and globally.

2.P.02 Performance Example:

- Identify and/or collect a variety of species of a local beach:
 - Analyze local tide charts to plan for the maximum availability of the intertidal zone.
 - Use field guides to identify plants, invertebrates, birds, etc.
 - Create a food web utilizing species observed in the field.

NOTES:

*Shading indicates supplemental/advanced learning standards and objectives.

Supplemental learning objectives and standards may also be taken from the Environmental Technology Concentration.

Strand 3: Embedded Academics

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

Academic Crosswalks

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

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

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

Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics)

Technology/Engineering

Strand 4: Employability and Career Readiness

4.A Career Exploration and Navigation

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

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

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

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

4. A Performance Examples:
- Conduct research to analyze and present on specific careers within a cluster.
 - Conduct web-based job search using sites such as Monster.com, CareerBuilder.com, Indeed.com, Snagajob.com, Simplyhired.com and others.
 - Create profile on social media/networking site such as LinkedIn and/or LinkedIn University for postsecondary research and employment opportunities.
 - Complete online job application.
 - Conduct and videotape practice interviews for instructor and student analysis.
 - Provide students with sample employment and benefit packages for evaluation.

4.B Communication in the Workplace

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

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

4.C Work Ethic and Professionalism

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

- 4.C.05.01 Display ethical behavior in use of time, resources, computers and information.
- 4.C.05.02 Identify the mission of the organization and/or department.
- 4.C.05.03 Explain the benefits of a diverse workplace.
- 4.C.05.04 Demonstrate a respect for diversity and its benefit to the workplace.

- 4.C.06 Interact appropriately with coworkers.
 - 4.C.06.01 Work productively with individuals and in teams.
 - 4.C.06.02 Develop positive mentoring and collaborative relationships within work environment.
 - 4.C.06.03 Show respect and collegiality, both formally and informally.
 - 4.C.06.04 Explain and follow workplace policy on the use of cell phones and other forms of social media.
 - 4.C.06.05 Maintain focus on tasks and avoid negative topics or excessive personal conversations in the workplace.
 - 4.C.06.06 Negotiate solutions to interpersonal and workplace conflicts.

4. C Performance Examples:

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

Student Organizations

Business Professionals of America

www.bpa.org

Selected Websites

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

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

Strand 5: Management and Entrepreneurship Knowledge and Skills

5.A Starting a Business

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

5. A Performance Examples:

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

5.B Managing a Business

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

5. B Performance Examples:

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

5.C Marketing a Business

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

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

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

5.D Financial Concepts and Applications in Business

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

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

5.E Legal/Ethical/Social Responsibilities

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

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

Selected Websites

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

Glossary

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

Term

Chain of Command and Organizational Structure

**Definition**

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

FICA

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

Income Statement

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

Market Research

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

Marketing Mix

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

Methods to Track Inventory, Productivity and Labor Cost

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

Promotional Tools and Techniques

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

Supply Chain

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

Target Market

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

Strand 6: Technology Literacy Knowledge and Skills

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

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

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

Appendices

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

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

Embedded Academic Crosswalks

Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
Multiple Standards	RI.1.11-12	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
Performance Example: <ul style="list-style-type: none"> Select an article that relates to the current topic being covered. Create an open response question that aligns to the article. Be sure the open response question requires students to analyze and cite the content of the article, including what it directly states and what is inferred and or left uncertain. 		
Multiple Standards	RI.3.11-12	Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.
Performance Example: <ul style="list-style-type: none"> Select a case study or a local environmental issue. Have students conduct a thorough analysis of the issue. This analysis should include stakeholders and their corresponding perspectives, as well as events leading up to the current issue. 		
Multiple Standards	RI.7.11-12	Integrate and evaluate multiple sources of information presented in different media or formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
Performance Example: <ul style="list-style-type: none"> Provide students with a modern science question. Assign them to research the question online and come up with an answer using three or more reliable sources. Be sure that some of their research incorporates visual and or quantitative formatted media and that all of their resources are cited appropriately. 		
Multiple Standards	W.2.11-12 (a-f)	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
Performance Example: <ul style="list-style-type: none"> Assign students a topic or allow students to select a topic related to the unit being covered. Have students conduct background research and gather information to write a 3-5 page topical research paper. The paper should follow the guidelines set in the above standard. One way to show the expectations to students would be to set the above standard into a rubric for assessment. 		
	W.4.11-12	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
Performance Example: <ul style="list-style-type: none"> Assign students an argumentative essay related to a local and/or current issue. Define to students who their essay is going to, i.e. a congressman or a local home owner. Students' essays should be written toward the assigned audience, well organized, and make a strong argument for their perspective. 		
Multiple Standards	W.7.11-12	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

<p>Performance Example:</p> <ul style="list-style-type: none"> • Short research project: See above ELA standard. RI.7.11-12 for a performance example. • Sustained research project: • Assign students a research project and paper. Allow students to create their own research question. Before they begin conducting field or lab research, require them to conduct a thorough background study of their topic. This should be an entire section of their written paper and resources they use should be thoroughly cited throughout their paper. 		
Multiple Standards	W.8.11-12	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
<p>Performance Example:</p> <ul style="list-style-type: none"> • See above sustained research project for ELA standard W.7.11-12. In the background study section of their paper there should be multiple citations which are formatted properly, contribute to the validity of the paper, and guide the reader to the purpose of the hands on research that will be discussed later in the paper. 		
Multiple Standards	W.10.11-12	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Throughout the course require students to keep a scientific notebook/journal. Some entries will be one time reflective experience based entries. Some entries will be over a longer duration such as components to a research study including background information, data collection, and analysis. 		
Multiple Standards	SL.1.11-12 (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 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Assign students a reading such as a case study prior to class. Require students to come to the discussion with some notes about the case study that they would like to discuss. During class conduct a discussion being sure to emphasize the skills noted in the above standard. 		
	SL.4.11-12	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
Multiple Standards	SL.5.11-12	Make strategic use of digital media (textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Allow students to select a research topic related to the current unit. Assign students a presentation based project around the selected topic that they will present to the class upon completion. The presentation should be well planned, organized, and geared to their audience. As part of this assignment require students to develop digital media that enhances their presentation and the audience’s understanding of the topic. 		

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.E.02.03	MA.N-Q.3.a	Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. Identify significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure. ★
<p>Performance Example:</p> <ul style="list-style-type: none"> Students are instructed on how to use, maintain and calibrate environmental bench top sampling meters (pH, DO, specific conductivity, and spectrophotometers). The students are instructed to pay close attention to the equipments' unit measure along with the tool's accuracy and precision. Students construct Standard Operating Procedures for the equipment that they are using, maintaining and calibrating. As part of the SOP they are asked to identify significant figures in recorded measures and the precision of the tools used to measure. 		
2.H.01.03	G-GMD.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. *
<p>Performance Example:</p> <ul style="list-style-type: none"> Students are instructed on the processes used in a typical municipal wastewater treatment facility (e.g. preliminary, primary, secondary, advanced or tertiary, disinfection, and de-chlorination). The students tour a municipal waste water treatment facility taking note of the variety of shaped settling, storage and containment vessels used in the waste water treatment process. The students are asked to design a treatment facility that will treat a specific volume of influent. Students are instructed on the volume formulas for cylinders, pyramids, cones, and spheres. The students are asked to calculate the size of the settling, storage and containment vessels used in their designed waste water treatment's preliminary, primary, secondary, and tertiary process. 		
2.C.02.02	S-ID.1	Represent data with plots on the real number line (dot plots, histograms, and box plots). *
<p>Performance Example:</p> <ul style="list-style-type: none"> Students are instructed on the importance and methods of studying wildlife populations. (quadrat, line transect, mark recapture). The students conduct field population study using a variety of methods. The students retrieve and record their samples data. Students are instructed on applying the Petersen and Lincoln methods to calculate the population estimates. The instructor reviews methods of plotted data in dot plots, histograms, and box plots. Students use the examples to plot and communicate their population study results. 		
2.C.05.01	G-SRT.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. *
<p>Performance Example:</p> <ul style="list-style-type: none"> Students are instructed on how to measure the height of a tree using different clinometers. Students use the tangent table to calculate the height of the tree. The instructor reviews how trigonometry ratios are applied to the calculation of the tree's height. The students then solve tree measurements problems given a variety of tangent, and angles of elevation. 		
2.A.01.01	S-IC.3	Make inferences and justify conclusions from sample surveys, experiments, and observational studies. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. *

* indicates Modeling standard.

(+) indicates standard beyond College and Career Ready.

<p>Performance Example:</p> <ul style="list-style-type: none"> • Students investigate greenhouse gasses and their potential long-term impacts on global climate change. They are asked to search for statistical data supporting or dismissing climate change. • The instructor reviews examples of how current data sample surveys, experiments, and observational studies support the author's views on climate change. • Students take part in a climate change debate. As part of their defense they must present statistical data to make inferences and justify their assigned position. 		
2.C.01.08	N-VM.6	Perform operations on matrices and use matrices in applications. (+) Use matrices to represent and manipulate data.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students perform a population study of Atlantic Silverside fish (<i>Menidia menidia</i>) at a local barrier beach. They use a seine net to collect fish samples once a week for six weeks. Students record the numbers of silversides collected and their total length. Along with the silversides they record other species of fish and determine if they are juvenile or adults. • Students are instructed on the construction and use of Matrices. • Students construct Matrices including the data they collected from the field activity. Students use the Matrices to evaluate the current school's stability. Using the Matrices patterns they predict future changes in the silverside population and what other species will coexist with them and why. 		
2.G.01.07	G-CO.12	Make geometric constructions. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i>
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students are instructed on the utilization of a variety of tools to measure energy use and assess energy use impact (e.g. Kill-A-Watt meter, light meter, hygrometer, online calculators, etc.). Solar noon and solar south are investigated while discussing solar energy and location of solar collectors. • The instructor reviews how geometric constructions can be used to evaluate the best location of solar panels on a site. • Student use a variety of mechanical drawing tools to make geometric constructions that calculate the noon solar angle. The constructions will cover a variety of latitudes on different dates. Their results are compared and contrasted. 		
2.H.01.14	A-CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. <i>For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i> *
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students are instructed on calculating groundwater velocity using permeability and hydraulic gradient data. The instructor introduces Darcy's law which mathematical formula summarizes several familiar properties that groundwater flowing in aquifers exhibit. Students use the equation to highlight the pressure gradient over a distance and determine the groundwater flow rates. 		

* indicates Modeling standard.

(+) indicates standard beyond College and Career Ready.

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.02.02	Earth/Space Science H.S Matter and Energy in the Earth System - 1.5	Explain how the revolution of Earth around the Sun and the inclination of Earth on its axis cause Earth's seasonal variations (equinoxes and solstices).
<p>Performance Example:</p> <ul style="list-style-type: none"> • Instruct the class on seasonal change and how it occurs. • Instruct the class on how to differentiate between weather and climate and the factors which affect them. • Upon mastery of this skill, ask the class if they can display their knowledge by creating a diagram that shows the primary layers of the atmosphere and identifying the basic types of clouds and their associated weather patterns for seasonal variations. • Conclude instruction on this concept by allowing students to display knowledge on field studies to interpret a weather map and demonstrate practices for gathering meteorological data that displays knowledge of season change and its various types of weather associated with each season. 		
2.G.01.03	Earth/Space Science H.S Energy Resources in the Earth System – 2.1	Recognize, describe, and compare renewable energy resources (solar, wind, water, biomass) and nonrenewable energy resources (fossil fuels, nuclear energy).
<p>Performance Example:</p> <ul style="list-style-type: none"> • Instruct the class on the difference between renewable and nonrenewable energy resources. • Instruct the class on the advantages and disadvantages of alternative fuels and energy resources. • Upon mastery of this skill, ask the class if they can determine the difference between renewable and nonrenewable energy resources and the benefits, cost, and process for operation and maintaining a specific renewable/nonrenewable energy source. 		
2.C.03.04	Earth/Space Science H.S 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.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Instruct the class on the basic soil particles size (sand, silt, clay, loam). • Instruct the class on the role of drainage class, porosity and permeability play in the storage and transport of water and soil. • Upon mastery of this skill, ask the class if they can display their knowledge by creating a diagram that shows the soil horizons for a given site. • Conclude instruction on this concept by allowing students to display knowledge on field studies to demonstrate practices for conducting soil tests utilizing a given soil classification system (such as USDA) to determine factors that lead to soil erosion and determine soil conservation practices. 		
2.B.04.01	Earth/Space Science H.S Earth Processes and Cycles – 3.6	Describe the rock cycle, and the processes that are responsible for the formation of igneous, sedimentary, and metamorphic rocks. Compare the physical properties of these rock types and the physical properties of common rock-forming minerals.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Instruct the class on the three main rock types and how the process works. • Instruct the class on the concepts behind plate tectonics and continental drift theories. • Upon mastery of this skill, ask the class if they can display their knowledge by creating a diagram that shows the rock cycle and the physical properties for the formation of igneous, sedimentary, and metamorphic rocks. 		

- Conclude instruction on this concept by allowing students to display knowledge on field studies by collecting various rocks and, explaining the process for the formation of igneous, sedimentary, and metamorphic rocks.

Life Science (Biology)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Biology Learning Standard
2.C.04.07 2.C.05.01	5.2	Describe species as reproductively distinct groups of organisms. Recognize that species are further classified into a hierarchical taxonomic system (kingdom, phylum, class, order, family, genus, species) based on morphological, behavioral, and molecular similarities.
	5.1	Explain how evolution is demonstrated by evidence from the fossil record, comparative anatomy, genetics, molecular biology, and examples of natural selection.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Students develop a matrix chart for documenting species characteristics and classifications. Students then take the charts on a field experience (local zoo/aquarium/botanical garden) and identify visual indications related to their classifications. Upon returning to the classroom, students revise or edit their original charts based on the new information collected from the field experience. 		
2.B.01 2.M.03	6.2	Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Choose three locations around the school to assess the level of habitat destruction and develop a plan to minimize habitat loss : <ul style="list-style-type: none"> ○ Assess the loss of habitat, and explain the process. ○ Investigate/describe the effect human development has on habitats. ○ Recommend measures to balance human inhabitation and habitat preservation. • Explore how overfishing could cause quick evolutionary change: <ul style="list-style-type: none"> ○ Investigate the effects of overfishing on fish populations. ○ Gather data and analyze it. ○ Draw conclusions on evolutionary changes. 		
2.C.04.01 2.C.04.02 2.C.04.03 2.M.01.04	6.3	Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, and mutualism) add to the complexity of biological communities.
<p>Performance Example:</p> <ul style="list-style-type: none"> • Study a pond food web: <ul style="list-style-type: none"> ○ Take samples from the surface, the bottom and sediments. ○ Examine water samples under the microscope. ○ Look for birds, fish, turtles, and egg masses. ○ Build a food web for the pond. 		
2.B.02.01 2.M.01.01	6.4	Explain how water, carbon, and nitrogen cycle between abiotic resources and organic matter in an ecosystem, and how oxygen

2.M.01.02		cycles through photosynthesis and respiration.
<p>Performance Example:</p> <ul style="list-style-type: none"> Students research the water cycle in a watershed through a class project to graph/diagram the cycles identifying the stages and labeling specific aspects of the cycle. If able, students can break down into groups representing different regions (with a variety of climates) and diagram water cycles in watersheds from across the globe. After presenting their diagrams, they can engage in a discussion regarding the similarities and differences between the regions. 		
2.B.05.02 2.B.05.03	5.3	Explain how evolution through natural selection can result in changes in biodiversity through the increase or decrease of genetic diversity within a population.
<p>Performance Example:</p> <ul style="list-style-type: none"> Measure the biodiversity richness and abundance of an ecosystem by exploring a field site. This could include installing and monitoring insect traps, collecting aquatic macro invertebrates using kick nets, leaf-litter bags etc. Students then graph the data from the model ecosystems and use the data to introduce frequency and biodiversity indices. (e.g. Shannon-Weiner). 		
2.M.02.01 2.M.02.02 2.M.02.04	6.1	Explain how birth, death, immigration, and emigration influence population size.
<p>Performance Example:</p> <ul style="list-style-type: none"> Students conduct a research project involving the bird species in the school environment. Through this process, they research and document life cycle, migration and population sizes. The data collected is compared to scientific surveys for New England migrations of the identified bird species. With their results, students make recommendations to support bird populations in a natural habitat. Scientific research components can include: Sampling along a transect, Point sampling, Feeder station sampling. 		
	6.2	Analyze changes in population size and biodiversity (speciation and extinction) that result from the following: natural causes, changes in climate, human activity, and the introduction of invasive, non-native species.
<p>Performance example:</p> <ul style="list-style-type: none"> Students develop a guided tour script for a trip into a local or state park. Included in this presentation is a discussion and explanation of how natural causes, climate changes, human impact and invasive species impact the plants and organisms. Students also identify plants that have value in our society (medicinal, food, seasoning, cleaning etc.). 		
	6.3	Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels. Describe how relationships among organisms (predation, parasitism, competition, commensalism, and mutualism) add to the complexity of biological communities.
<p>Performance Example:</p> <ul style="list-style-type: none"> Build an Aquarium and/or Terrarium in your classroom using algae/plants as moss, grass, and other plants on the habitat's floor and insects. Observe feeding on the plant life within the environment. Add higher ranks of consumers (carnivores). 		

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.B.03	4.6	Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.
Performance Example: <ul style="list-style-type: none"> Define acid deposition. Identify the major sources of acid deposition. Create an excel table, listing the sources, atmospheric chemical processes, and finally the chemical formula associated with each process. 		
2.C.02	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: <ul style="list-style-type: none"> Determine why students cannot thoroughly cook their macaroni and cheese when camping at very high elevations (greater than 3,000 feet). Students should illustrate their final answer and discuss the effect of elevation on gas pressure and volume, as well as changes in the boiling point. 		
2.C.03	SIS2.f	Properly use instruments, equipment, and materials (scales, probe ware, meter sticks, microscopes, and computers) including set-up, calibration (if required), technique, maintenance, and storage.
Performance Example: <ul style="list-style-type: none"> Students quantify the differences in soils collected from different locations: – an active crop field, a backyard, an abandoned field, and a forest floor. What is the effect of different soil histories on the availability of soil nitrogen, phosphorus, potassium, and pH? 		
2.F.01	SIS2.a-e	Design and conduct scientific investigations.
Performance Example: <ul style="list-style-type: none"> Design a field study to determine the affect of different land use practices(e.g. agriculture fields, livestock grazing, suburban streets, park land) on adjacent water quality (e.g. orthophosphate, nitrate, pH, dissolved oxygen, and chlorophyll). 		
2.F.02	SIS2.f	Properly use instruments, equipment, and materials (scales, probeware, meter sticks, microscopes, and computers) including set-up, calibration (if required), technique, maintenance, and storage.
Performance Example: <ul style="list-style-type: none"> Calibrate and use dissolved oxygen and pH meters to measure changes in concentration due to fish respiration over time. 		
2.G.01	6.4	Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.
Performance Example: <ul style="list-style-type: none"> Describe the process of recycling aluminum, including the calculations for energy used and lost in the cycle. 		
2.H.01	4.6	Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate

Performance Example:		
<ul style="list-style-type: none"> Name and write the chemical formulas of several examples of each of the common classes of hazardous chemicals (e.g. petroleum products, chlorinated solvents, VOCs, PCBs, and metals). 		
2.I.01	SIS2.f	Properly use instruments, equipment, and materials (scales, probeware, meter sticks, microscopes, and computers) including set-up, calibration (if required), technique, maintenance, and storage.
Performance Example:		
<ul style="list-style-type: none"> Collect samples of water from a local pond to test for 5-day biochemical oxygen demand and turbidity. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
2.C.02	3.1	Explain how heat energy is transferred by convection, conduction, and radiation.
Performance Example:		
<ul style="list-style-type: none"> Demonstrate the different ways heat energy from the sun is transferred throughout the atmosphere, the land, and the oceans. 		
2.G.01	5.5	Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage.
Performance Example:		
<ul style="list-style-type: none"> Conduct a home energy survey, calculating daily, monthly, and yearly power demands. 		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

Environmental Science Potential Certifications/Credentials (overall)

1. 10-Hour OSHA General Industry Card/Credential*
OSHA General Industry Training Guidelines
2. 10-hour Construction Industry Card/Credential*
OSHA Construction Industry Training Guidelines
3. CPR & First Aid Training Card/Credential*
American Heart Association and American Red Cross

Natural Resource Management Concentration Potential Certifications/Credentials

1. Wilderness First Aid *
Stonehearth Open Learning Opportunities or Wilderness Medical Assoc.
2. Massachusetts Boater's Safety *
MA Environmental Police
3. Life Guard *
American Red Cross or BSA
4. SCUBA (Open water I) *
NAUI or PADI or SSI
5. Massachusetts Hunter Education *
MA Div. Fisheries & Wildlife
6. Massachusetts Trapper Education
MA Div. Fisheries & Wildlife
7. Massachusetts Problem Animal Control
MA Div. Fisheries & Wildlife
8. Certified Timber Harvester
MA Dept. Cons. & Recreation
9. Certified Interpretive Guide *
National Association for Interpretation
10. Marine Safety Training
Marine Safety Consultants, Inc. or SMAST
11. Seasonal Conservation Law Enforcement Training
Association of National Park Rangers
12. Massachusetts Pesticide Applicators License
Massachusetts Department of Agricultural Resources

Environmental Technology Concentration Potential Certifications/Credentials

1. 40-Hour OSHA Hazardous Waste Operations and Emergency Response(HAZWOPER) Certificate*
OSHA HAZWOPER Fact Sheet
OSHA HAZWOPER Publication 3114
OSHA HAZWOPER Gen. Ind. Standard 1910.120
OSHA HAZWOPER Construction Standard 1926.65
2. OSHA Permit-Required Confined Space Certificate*
OSHA Permit-Required Confined Space Publication 3138

OSHA Permit-Required Confined Space Std. 1910.146

3. OSHA Disaster Site Worker Card/Credential
OSHA Disaster Site Worker Program Requirements
4. Certified Operator of a Drinking Water Supply Facility
MA Board of Certification of Operators of Drinking Water Supply Facilities
5. Wastewater Operator Certification (17 yr old students eligible)
MA DEP Wastewater Operator Certification
6. Sustainability 101 Certificate*
Green Education Foundation Institute

*Can be earned by student prior to graduation.

Other

Reference Materials

Environmental Sciences Recommended Texts

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- Burton, L. D. V. (2009). *Environmental science: fundamentals and applications*. Delmar.
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Natural Resource Management Recommended Texts

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Student Organizations

- Skills USA www.maskillsusa.org

Selected Websites

- U. S. Department of Agriculture (USDA) www.USDA.gov/
- U. S. Environmental Protection Agency (EPA) www.epa.gov/
- U. S. Department of Energy (DOE) www.energy.gov/
- U. S. Fish and Wildlife Service www.fws.gov/
- U. S. National Park Service www.nps.gov/