



MASSACHUSETTS
DEPARTMENT of
EDUCATION

**Vocational Technical Education
Framework**

**Agriculture and Natural Resource
Cluster**

Environmental Science and Technology

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Strand 1: Safety Health Knowledge and Skills

1.A Define health and safety regulations.

- 1.A.01a Identify and apply OSHA and other health and safety regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.02a Identify and apply EPA and other environmental protection regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.03a Identify and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.04a Explain procedures for documenting and reporting hazards to appropriate authorities.
- 1.A.05a List penalties for non-compliance with appropriate health and safety regulations.
- 1.A.06a Identify contact information for appropriate health and safety agencies and resources.

1.B Demonstrate health and safety practices.

- 1.B.01a Identify, describe and demonstrate the effective use of Material Safety Data Sheets (MSDS).
- 1.B.02a Read chemical, product, and equipment labels to determine appropriate health and safety considerations.
- 1.B.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures.
- 1.B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and breathing apparatus.
- 1.B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics.
- 1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits.
- 1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom.
- 1.B.08a Describe safety practices and procedures to be followed when working with and around electricity.
- 1.B.09a Properly handle, store, dispose of, and recycle hazardous, flammable and combustible materials.
- 1.B.10a Demonstrate proper workspace cleaning procedures.
- 1.B.11c Demonstrate proper spacing distance from others when using tools.

Performance Examples:

1. Describe a safety plan, including factors related to protecting the environment, for employees under your supervision in the workplace or at a job site.
2. Given a specific task, describe or demonstrate proper safety procedures/methods.

3. When presented with a hazardous situation that could develop in shop, the student will evaluate the situation and suggest procedures and/or practices that would resolve the hazardous situation.

1.C Demonstrate responses to situations that threaten health and safety.

- 1.C.01a Illustrate First Aid procedures for potential injuries and other health concerns in the occupational area.
- 1.C.02a Describe the importance of emergency preparedness and an emergency action plan.
- 1.C.03a Illustrate procedures used to handle emergency situations and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures.
- 1.C.04a Identify practices used to avoid accidents.
- 1.C.05a Identify and describe fire protection, precautions and response procedures.
- 1.C.06a Discuss the role of the individual and the company/organization in ensuring workplace safety.
- 1.C.07a Discuss ways to identify and prevent workplace/school violence.
- 1.C.08 Identify a victim of cardiac arrest by checking Airway, Breathing, and Circulation.
- 1.C.09 Perform one-rescuer adult cardiopulmonary resuscitation.
- 1.C.10 Demonstrate proper care for an unconscious choking victim with 100% accuracy.
- 1.C.11 Demonstrate how to control bleeding by the use of direct pressure, elevation, and pressure points.
- 1.C.12 Demonstrate how to immobilize a muscle, bone, or joint injury by the use of a sling and/or splint.
- 1.C.13 Demonstrate proper care for burns.

Performance Example:

- 1. Students successfully complete American Red Cross or American Heart Association First Aid and CPR Certification and receive a course completion card.

1.D Obtain 40-hour OSHA Hazardous Waste Operations and Emergency Response Training and Certification.

- 1.D.01 Identify the types of work environments that require hazardous material training.
- 1.D.02 List the components of the Hazard Communication Program (Right-to-Know).
- 1.D.03 Identify physical and health hazards of chemicals via labels and material safety data sheets (MSDS).
- 1.D.04 List the hazard categories used in the NFPA and HMIS labeling classification.
- 1.D.05 Identify the classes of hazardous materials according to EPA and DOT.
- 1.D.06 Utilize the DOT Emergency Response Guidebook to determine response procedures to hazardous chemical spills.
- 1.D.07 Define toxicological terminology, such as acute, chronic, local, systemic and dose.

- 1.D.08 Identify common exposure limits (e.g. PELs, TLVs, REL, IDLH, STEL).
- 1.D.09 Identify exposure routes chemicals take to enter the body.
- 1.D.10 Define chronic body responses to chemical overexposure, such as mutagen, teratogen and carcinogen.
- 1.D.11 Utilize the NIOSH Pocket Guide to Chemical Hazards to determine the PEL and/or REL of chemicals.
- 1.D.12 Utilize the ACGIH Threshold Limit Value to determine the TLV of chemicals.
- 1.D.13 Demonstrate use and calibration of the PID.
- 1.D.14 Demonstrate use and calibration of a Multimeter (LEL, O₂, CO, H₂S).
- 1.D.15 Perform a Jar Headspace Analytical Screening Procedure.
- 1.D.16 Demonstrate the use of Detector Tubes.
- 1.D.17 Explain the use and limitations of direct reading instrumentation.
- 1.D.18 List the EPA Levels of Protection.
- 1.D.19 Determine selection and use of eye protective equipment.
- 1.D.20 Determine selection and use of chemical protective clothing.
- 1.D.21 Determine selection and use of chemical protective gloves.
- 1.D.22 Describe causes of chemical resistance failure of PPE.
- 1.D.23 Identify types of respiratory hazards.
- 1.D.24 Perform the decision logic for selecting respiratory protection.
- 1.D.25 Inspect and perform routine maintenance and decontamination of respirators.
- 1.D.26 Participate in respirator fit testing procedures.
- 1.D.27 Demonstrate the ability to wear an SCBA, air supplied respirator.
- 1.D.28 Demonstrate proper PPE donning and doffing procedures.
- 1.D.29 Identify waste-site work zones and describe the functions of each zone.
- 1.D.30 Identify the three classes of sorbents.
- 1.D.31 Identify the forms of commercial sorbents.
- 1.D.32 Identify basic recovery equipment.
- 1.D.33 Match recovery techniques with the chemical and physical properties of the spilled material involved.
- 1.D.34 Demonstrate 55-gallon drum over packing.
- 1.D.35 Describe the use of engineering controls and equipment to minimize risk from site hazards.
- 1.D.36 Identify hazards associated with confined spaces.
- 1.D.37 List and demonstrate use of analytical instruments to test confined space atmospheres.
- 1.D.38 Demonstrate techniques for mobilizing and demobilizing a decontamination line.
- 1.D.39 List considerations for determining the extent of decontamination activities required.
- 1.D.40 Explain decontamination methods.
- 1.D.41 Complete a Health and Safety Plan.
- 1.D.42 Complete a Hazardous Substance Information Form.
- 1.D.43 Participate in the implementation of a Health and Safety Plan.
- 1.D.44 Explain the requirements of a medical monitoring program.
- 1.D.45 Explain the labeling requirements for hazardous waste transportation and disposal.
- 1.D.46 Complete a hazardous waste manifest.

1.D.47 Summarize the Resource Conservation and Recovery Act.

Performance Example:

1. Upon completion of the program students participate in a simulated hazardous materials spill.
2. Students are assigned specific roles within the hazardous materials response team.
3. Students develop a health and safety plan outlining requirements for protecting the health and safety of responders during all activities to be conducted during the scenario.
4. Students attend a debriefing to review both the positive and negative points of the drill.

Strand 2: Technical Knowledge and Skills

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

- 2.A.01c Select tools and equipment.
- 2.A.02c Identify standard tools, equipment, and safety procedures.
- 2.A.03c Follow operating instructions.
- 2.A.04c Set up/adjust tools and equipment.
- 2.A.05c Demonstrate proper maintenance of all tools.
- 2.A.06c Store tools properly.

Performance Example:

1. Demonstrate operation of a specific tool or piece of equipment. Given a specific task, describe the tool/equipment required, the safety issues and training required, how to operate, and basic maintenance functions to be performed by the operator.

2.B Demonstrate practices related to limnology (freshwater systems).

- 2.B.01 Explain concepts of pond succession and cultural eutrophication.
- 2.B.02 Explain thermal stratification and seasonal turnovers.
- 2.B.03 Prepare a vernal pool state certification application.
- 2.B.04 Measure velocity and flow rate in a stream.
- 2.B.05 Conduct water-quality tests using field test kits.
- 2.B.06 Collect samples for microbiological testing.
- 2.B.07 Conduct fecal coliform tests.
- 2.B.08 Conduct total coliform tests.
- 2.B.09 Collect biological samples using equipment such as an Ekman dredge and surber sampler.
- 2.B.10 Construct a lake profile.
- 2.B.11 Identify common benthic macroinvertebrate organisms.

Performance Examples:

1. Students will participate in a water quality-monitoring project within the local community.
2. Students will use the proper techniques for collecting and testing water samples to determine the physical, chemical and biological parameters of a test site.
3. Students will understand the different constituents that must be tested for and how to compute the overall water quality index for the site.

2.C Describe resources and concepts related to wildlife biology.

- 2.C.01 Identify organisms using a dichotomous key.
- 2.C.02 Calculate population densities using a population census.
- 2.C.03 Conduct a population census using mark-recapture, transect, or quadrat methods.
- 2.C.04 Summarize the Endangered Species Act.
- 2.C.05 Summarize applicable Massachusetts Fish and Wildlife Regulations.
- 2.C.06 Construct food webs.
- 2.C.07 Identify biotic and abiotic factors in the environment.

Performance Examples:

1. Students will evaluate different methods of taking a population census and will estimate the size of a population by taking a sample census using a model ecosystem.
2. Students will estimate the size of a population of animals in a model habitat using the Mark-Return-Recapture method.

2.D Describe resources and concepts related to geology.

- 2.D.01 Identify common minerals by testing mineral properties.
- 2.D.02 Identify common rock types.
- 2.D.03 Identify glacial geologic features common to New England.
- 2.D.04 Identify basic soil types.
- 2.D.05 Describe soil properties using a hand lens.
- 2.D.06 Prepare a soil-boring log from soil samples.
- 2.D.07 Illustrate concepts behind plate tectonics and continental drift theories.
- 2.D.08 Draw a diagram of the earth's composition.

Performance Example:

1. Students take soil core samples and complete soil boring logs at different locations, distinguishing the variability between soil horizons. Students will gain understanding of how the different soil layers were developed and compare and contrast boring logs from varied locations (e.g. wetland vs. glacial till).

2.E Describe resources for and concepts related to aquaculture and marine science.

- 2.E.01 Identify the components and function of a recirculating aquaculture system.
- 2.E.02 Demonstrate the maintenance of pumps, clarifiers, and filters for aquaculture systems.
- 2.E.03 Perform chemical adjustments in tanks.
- 2.E.04 Take measurements using water-quality parameters using field test kits.
- 2.E.05 Measure salinity using a refractometer.
- 2.E.06 Measure density using a hydrometer.
- 2.E.07 Identify common marine fish and invertebrates.
- 2.E.08 Collect field specimens using seine nets, plankton tows, and fish traps.

Performance Example:

1. Students will measure water quality parameters necessary for maintenance of a healthy fish population and compared to fish species tolerance guidelines.
2. Students will gain understanding of water chemistry necessary to maintain a population of organisms in a controlled environment.

2.F Describe resources for and concepts related to land use planning and watershed management.

- 2.F.01 Interpret aerial photographs.

- 2.F.02 Identify major environmental issues in agricultural land use.
- 2.F.03 Construct a contour map from individual data points.
- 2.F.04 Identify common categories of pollutants and their properties.
- 2.F.05 Identify common sources of pollutants.
- 2.F.06 Identify primary watershed management practices used for wellhead or reservoir protection.
- 2.F.07 Identify and differentiate between point and nonpoint sources of pollution.
- 2.F.08 Determine watershed boundaries and direction of stream flow from topographic maps.
- 2.F.09 Find distances and directions on maps; understand.
- 2.F.10 Explain symbols, scale, and elevation listed on a map.
- 2.F.11 Find locations and navigate between locations with compass and topographic map.
- 2.F.12 Identify wetlands using soil and plant criteria.
- 2.F.13 Identify trees using a dichotomous key.
- 2.F.14 Measure tree height using a Biltmore stick.
- 2.F.15 Measure tree diameter using a Biltmore stick.
- 2.F.16 Measure tree height using clinometers.
- 2.F.17 Calculate your pace and measure an area by pacing.
- 2.F.18 Determine the percentage of sand, silt, clay of a sample.
- 2.F.19 Determine the pH of soil samples.
- 2.F.20 Determine the NPK of a soil sample.

Performance Examples:

1. Students will use a map to derive distance between two points using scale and elevation.
2. Students will prepare and participate in the Massachusetts State Envirothon Competition.

2.G Use appropriate mapping technologies.

- 2.G.01 Describe various coordinate systems and their applications.
- 2.G.02 Retrieve spatial data (contours, streets, lakes, rivers/streams, buildings, et) from GIS databases.
- 2.G.03 Create maps and overlays of specified geographical locations.
- 2.G.04 Create land-use maps to identify conflicting land-use using GIS data.
- 2.G.05 Determine position on a USGS map using latitude & longitude.
- 2.G.06 Determine position on a USGS map using the Universal Transverse Mercator (UTM).
- 2.G.07 Transfer coordinates from a GPS unit onto a map using a map plotter.
- 2.G.08 Transfer coordinates from a map onto a GPS unit using a map plotter.
- 2.G.09 Convert decimal degrees to degrees minutes and seconds.
- 2.G.10 Convert degrees minutes and seconds to decimal degrees.
- 2.G.11 Locate benchmarks in the field using a compass and topographic map.
- 2.G.12 Make a profile of a cross section of a study area using a topographic map.
- 2.G.13 Locate your position using latitude & longitude as indicated on a GPS unit.
- 2.G.14 Locate your position using the UTM as indicated on a GPS unit.

Performance Examples:

1. Students will work on a local study area using map overlays from a Geographic Information Systems (GIS) database.
2. Students will import data sets from an outside source, such as Mass GIS.
3. Students will demonstrate how to manipulate and create map overlays, to identify local wetlands, conservation lands, areas of biological significance and conflicting land-use issues.

2.H Describe concepts of meteorology.

- 2.H.01 Explain how the motion of the sun, earth, and moon affects seasons and climate.
- 2.H.02 Differentiate between weather and climate.
- 2.H.03 Describe the chemical composition of the atmosphere.
- 2.H.04 Identify the primary layers of the atmosphere.
- 2.H.05 Identify heat transfer mechanisms (conduction, convection, and latent heating).
- 2.H.06 Recognize the basic types of clouds and their associated weather patterns.
- 2.H.07 Interpret a weather map.
- 2.H.08 Explain the causes of lightning and safety precautions related to lightning.
- 2.H.09 Measure temperature, relative humidity, dew point, air pressure, and precipitation.
- 2.H.10 Convert among pressure units (e.g. atmospheres, millibars, inches of mercury).

Performance Example:

1. Students will monitor local weather conditions, gathering and recording data to characterize local weather patterns and regional weather systems.

2.I Describe resources for and concepts related to energy and air quality.

- 2.I.01 Measure common air-pollution parameters using field kits.
- 2.I.02 Identify major sources of air pollution.
- 2.I.03 Explain greenhouse effect, ozone depletion, and potential long-term impacts.
- 2.I.04 Identify major sources of acid rain.
- 2.I.05 Identify major sources of CFC emissions into the atmosphere.
- 2.I.06 Identify major sources of hydrocarbon emissions.
- 2.I.07 Describe the different devices and techniques for controlling emissions of air pollutants.
- 2.I.08 Identify the advantages and disadvantages of converting waste products to energy.
- 2.I.09 Summarize the Clean Air Act.
- 2.I.10 Describe main types of energy used in the US and their impacts to the atmosphere.

Performance Example:

1. Students will measure air quality parameters, gathering and recording data to identify potential air quality hazards.

2.J Define and use concepts of hydrogeology.

- 2.J.01 Construct a complete diagram of the hydrologic cycle.
- 2.J.02 Estimate the hydraulic properties of unconsolidated deposits (porosity, permeability, capillarity).
- 2.J.03 Describe confined/unconfined aquifers and their relationship to water table/potentiometric surfaces.
- 2.J.04 Calculate the hydraulic gradient from a water-table map.
- 2.J.05 Predict groundwater flow direction using a topographic map.
- 2.J.06 Create a contour map of the water table.

Performance Example:

1. Given a data set of groundwater elevations and an observation well location map, students will prepare a contour map of the water table, and indicate by drawing arrows the direction of groundwater flow.

2.K Describe resources for and concepts of applied water technology.

- 2.K.01 Construct a schematic diagram of a basic water distribution system.
- 2.K.02 Identify preliminary, primary, secondary, and advanced treatment processes.
- 2.K.03 Identify disinfection, dechlorination, and sludge-treatment processes.
- 2.K.04 Describe the function of microorganisms in municipal wastewater treatment processes.
- 2.K.05 Differentiate between organic and inorganic compounds.
- 2.K.06 Construct a schematic diagram of a basic municipal wastewater treatment facility.
- 2.K.07 Calculate dosing requirements in municipal wastewater treatment processes.
- 2.K.08 Record measurements from electrical and mechanical gauges and instruments.
- 2.K.09 Describe the operation of common pumps
- 2.K.10 Read gauges, charts, and meters used in municipal wastewater treatment plants.

Performance Example:

1. Students sit for the State of Massachusetts Level II Municipal Wastewater Operators Certification Examination.

2.L Describe resources for and concepts of environmental site assessment and remediation.

- 2.L.01 Explain the main elements of an ASTM Phase I Site Assessment.
- 2.L.02 Conduct historical research and use a regulatory database.
- 2.L.03 Interpret Sanborn Maps and air photos to identify potential environmental risks.
- 2.L.04 Identify locations for monitoring wells based on site information and site reconnaissance.
- 2.L.05 Collect soil samples using hand augers and install piezometers.
- 2.L.06 Demonstrate methods used to complete well-construction logs.
- 2.L.07 Measure field parameters (pH, specific conductance, temperature, DO).
- 2.L.08 Calibrate and use a photoionization detector (PID).

- 2.L.09 Conduct jar-headspace analytical screening on soil and groundwater samples.
- 2.L.10 Gauge an observation well using an oil/water interface probe and water-level indicator.
- 2.L.11 Convert depth-to-groundwater data to groundwater elevation using a common datum.
- 2.L.12 Prepare maps of groundwater constituent concentrations.
- 2.L.13 Conduct a bail-down test or slug test.
- 2.L.14 Identify common sources of soil and groundwater contamination.
- 2.L.15 Identify common chemicals of concern, including VOCs, PCBs, metals, and inorganics.
- 2.L.16 Collect groundwater samples for laboratory analyses.
- 2.L.17 Identify factors affecting fate, transport and remediation of chemicals in groundwater.
- 2.L.18 Identify soil and groundwater remediation systems for a given chemical and environmental setting.
- 2.L.19 Interpret process and instrumentation diagrams (P&ID).
- 2.L.20 Collect influent and effluent samples from remediation systems.
- 2.L.21 List Federal and State hazardous waste site cleanup regulations.

Performance Example:

1. Students will conduct records research on a given property according to the ASTM Standard using available federal, state, and local records, and draw conclusions regarding potential environmental liabilities at the property.

2.M Demonstrate practices related to laboratory and field sampling and testing.

- 2.M.01 Demonstrate proper record keeping.
- 2.M.02 Demonstrate how to use, maintain and calibrate environmental sampling meters (i.e. pH, DO, specific conductivity, turbidity, color meters, and spectrophotometers).
- 2.M.03 List correct procedures to collect and transport representative composite and grab samples.
- 2.M.04 Demonstrate correct preservation techniques and materials required for specific sampling activities.
- 2.M.05 Prepare and follow Standard Operating Procedures (e.g. autoclave, spectrophotometer).
- 2.M.06 Complete a chain of custody.
- 2.M.07 Demonstrate QA/QC sampling procedures (i.e. replicates, equipment blanks and trip blanks).
- 2.M.08 Demonstrate decontamination of equipment and tools used during sampling.
- 2.M.09 Prepare solutions of a specific concentration by diluting solutions of known concentrations.
- 2.M.10 Measure, contain, mix, and transport substances using common laboratory equipment (e.g. balances, microscopes, pipettes, volumetric flasks).

Performance Examples:

1. Students will develop proper field techniques for collecting and transporting samples gathered in the field.
2. Given a copy of an environmental site-specific field sampling and quality assurance/quality control plan students will choose the equipment and sampling techniques to be utilized.
3. The student will be prepared to defend the integrity of the collected field data and ensure the analytical results were not jeopardized during the monitoring and sampling activities.
4. Demonstrate the importance of proper methods for testing and keeping accurate records of all activities in a logbook.

Strand 3: Embedded Academic Knowledge and Skills

3.A English Language Arts

VTE #	Acad #	Standard	Grade	Topic
3.A.01c	2.4	Integrate relevant information gathered from group discussions and interviews for reports.	Pre-9	Language
3.A.02c	13.19	Identify and use knowledge of common graphic features (charts, maps, diagrams).	Pre-9	Reading
3.A.03c	19.21	Write reports based on research that includes quotations, footnotes or endnotes, and a bibliography.	Pre-9	Composition
3.A.04c	24.4	Apply steps for obtaining information from a variety of sources, organizing information, documenting sources, and presenting research in individual projects:	Pre-9	Composition
3.A.05c	24.5	Formulate open-ended research questions and apply steps for obtaining and evaluating information from a variety of sources, organizing information, documenting sources in a consistent and standard format, and presenting research.	9/10	Composition
3.A.06c	3.17	Deliver formal presentations for particular audiences using clear enunciation and appropriate organization, gestures, tone, and vocabulary.	11/12	Language
3.A.07c	4.27	Use general dictionaries, specialized dictionaries, thesauruses, histories of language, books of quotations, and other related references as needed.	11/12	Language
3.A.08c	19.27	For informational/expository writing: Write well-organized research papers that prove a thesis statement using logical organization, effective supporting evidence, and variety in sentence structure.	11/12	Composition
3.A.09c	24.6	Formulate original, open-ended questions to explore a topic of interest, design and carry out research, and evaluate the quality of the research paper in terms of the adequacy of its questions, materials, approach, and documentation of sources.	11/12	Composition

3.A.10c		Read technical manuals, guides, resource books and technical literature to gain information and solve problems (Operator's manual, service manuals and databases etc).		Voc
3.A.11c		Read, comprehend, and follow written technical directions for repairs, procedures and processes.		Voc

3.B Mathematics

VTE #	Acad #	Standard	Grade	Topic
3.B.01c	7.M.2	Given the formulas, convert from one system of measurement to another. Use technology as appropriate.	Pre-9	Measurement
3.B.02c	7.P.4	Solve linear equations using tables, graphs, models, and algebraic methods.	Pre-9	Patterns, relations, algebra
3.B.03c	7.P.6	Use linear equations to model and analyze problems involving proportional relationships. Use technology as appropriate.	Pre-9	Patterns, relations, algebra
3.B.04c	8.M.2	Given the formulas, convert from one system of measurement to another. Use technology as appropriate.	Pre-9	Measurement
3.B.05c	8.N.1	Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents.	Pre-9	Numbers
3.B.06c	10.D.1	Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plots, box-and-whisker plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.	9/10	Data Analysis, Probability and Statistics
3.B.07c	10.M.4	Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements.	9/10	Measurement
3.B.08c	10.P.8	Solve everyday problems that can be modeled using systems of linear equations or inequalities. Apply algebraic and graphical methods to the solution. Use technology when appropriate. Include mixture, rate, and work problems.	9/10	Patterns, relations, algebra

3.B.09	7.G.5	Use a ruler, protractor, and compass to draw polygons and circles.	Pre-9	Geometry
3.B.10	10.G.10	Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.	9/10	Geometry
3.B.11	10.G.8	Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.	9/10	Geometry
3.B.12	10.M.1	Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.	9/10	Measurement
3.B.13	12.G.5	Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.	11/12	Geometry
3.B.14	12.M.1	Describe the relationship between degree and radian measures, and use radian measure in the solution of problems, in particular, problems involving angular velocity and acceleration.	11/12	Measurement
3.B.15	12.M.2	Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense.	11/12	Measurement
3.B.16	12.P.8	Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use technology where appropriate. Include polynomial, exponential, logarithmic, and trigonometric functions; expressions involving absolute values; trigonometric relations; and simple rational expressions.	11/12	Patterns, relations, algebra
3.B.17	12.P.9	Use matrices to solve systems of linear equations. Apply to the solution of everyday problems.	11/12	Patterns, relations, algebra
3.B.18		Find for distances and area on land, survey and topographical maps.		Voc

3.C Science and Engineering/Technology\

VTE #	Acad #	Standard	Grade	Topic
3.C.01c	2	Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular), e.g., bacteria, yeast. In these single-celled organisms, one cell must carry out all of the basic functions of life.	Pre-9	Life Science
3.C.02c	3	Compare and contrast plant and animal cells, including major organelles (cell membrane, cell wall, nucleus, cytoplasm, chloroplasts, mitochondria, vacuoles).	Pre-9	Life Science
3.C.03c	4	Recognize that within cells, many of the basic functions of organisms (e.g., extracting energy from food and getting rid of waste) are carried out. The way in which cells function is similar in all living organisms.	Pre-9	Life Science
3.C.04c	10	Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.	Pre-9	Life Science
3.C.05c	2.3	Distinguish between plant and animal cells.		Biology
3.C.06c	2.4	Describe how cells function in a narrow range of physical conditions, such as temperature and pH, to perform life functions that help to maintain homeostasis.		Biology
3.C.07c	2.7	Provide evidence that the organic compounds produced by plants are the primary source of energy and nutrients for most living things.		Biology
3.C.08c	1.1	Identify the earth's principal sources of internal and external energy, e.g., radioactive decay, gravity, solar energy.		Earth Science
3.C.09c	1.1	Identify and explain the steps of the engineering design process, i.e., identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.		Eng/Tech
3.C.10c	1.5	Interpret plans, diagrams, and working drawings in the construction of a prototype.		Eng/Tech

3.C.11c	3.1	Differentiate between open (e.g., irrigation, forced hot air system) and closed (e.g., forced hot water system, hydroponics) fluid systems and their components such as valves, controlling devices, and metering devices.		Eng/Tech
3.C.12c	3.3	Explain the relationship among temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.		Eng/Tech
3.C.13c	4.2	Give examples of how conduction, convection, and radiation are used in the selection of materials, e.g., home and vehicle thermostat designs, circuit breakers.		Eng/Tech
3.C.14c	4.3	Identify the differences between open and closed thermal systems, e.g., humidity control systems, heating systems, cooling systems.		Eng/Tech
3.C.15c	4.4	Explain how environmental conditions influence heating and cooling of buildings and automobiles.		Eng/Tech
3.C.16c	4.5	Identify and explain the tools, controls, and properties of materials used in a thermal system, e.g., thermostats, R Values, thermal conductivity, temperature sensors.		Eng/Tech
3.C.17c	5.3	Explain the relationship between resistance, voltage, and current (Ohm's Law).		Eng/Tech
3.C.18c	2.4	Describe the relationship among energy, work, and power both conceptually and quantitatively.		Physics
3.C.19c	2.6	Identify appropriate standard international units of measurement for energy, work, power, and momentum.		Physics
3.C.20c	5.4	Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them.		Physics
3.C.21c	5.5	Identify appropriate units of measurement for current, voltage, and resistance, and explain how they are measured.		Physics
3.C.22	14	Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.	Pre-9	Life Science
3.C.23	15	Explain how dead plants and animals are broken down by other living organisms and how this process contributes to the system as a whole.	Pre-9	Life Science

3.C.24	16	Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organism.	Pre-9	Life Science
3.C.25	6.1	Explain how biotic and abiotic factors cycle in an ecosystem (water, carbon, oxygen, and nitrogen).		Biology
3.C.26	6.2	Use a food web to identify and distinguish producers, consumers, and decomposers, and explain the transfer of energy through trophic levels.		Biology
3.C.27	6.3	Identify the factors in an ecosystem that influence fluctuations in population size.		Biology
3.C.28	6.4	Analyze changes in an ecosystem resulting from natural causes, changes in climate, human activity, or introduction of non-native species.		Biology
3.C.29	6.5	Explain how symbiotic behavior produces interactions within ecosystems.		Biology
3.C.30	1.1	Describe the various conditions associated with frontal boundaries and cyclonic storms (e.g., thunderstorms, winter storms [nor'easters], hurricanes, and tornadoes) and their impact on human affairs, including storm preparations.		Earth Science
3.C.31	1.11	Explain the dynamics of oceanic currents, including upwelling, density, and deep water currents, the local Labrador Current and the Gulf Stream, and their relationship to global circulation within the marine environment and climate.		Earth Science
3.C.32	1.12	Describe the effects of longshore currents, storms, and artificial structures (e.g., jetties, sea walls) on coastal erosion in Massachusetts.		Earth Science
3.C.33	1.13	Explain what causes the tides and describe how they affect the coastal environment.		Earth Science
3.C.34	1.14	Explain how scientists study the earth system through the use of a combination of ground-based observations, satellite observations, and computer models of the earth system, and why it is necessary to use all of these tools together.		Earth Science

3.C.35	2.1	Recognize, describe, and differentiate between renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear) sources of energy.		Earth Science
3.C.36	2.2	Explain the advantage and limitations of renewable sources of energy.		Earth Science
3.C.37	2.3	Explain the advantage and limitations of nonrenewable sources of energy.		Earth Science
3.C.38	2.4	Describe ways in which people have tried to control the use of renewable and nonrenewable sources of energy, e.g., scientific advances, prices.		Earth Science
3.C.39	2.5	Describe the effects on the environment of using both renewable and nonrenewable sources of energy.		Earth Science
3.C.40	2.6	Describe ways in which scientists are addressing effects on the environment of using both renewable and nonrenewable sources of energy, e.g., creation of new technologies.		Earth Science
3.C.41	3.1	Explain that weather is the most significant source of erosion and how both physical and chemical weathering lead to the formation of sediments and soils, affect the shape of rocks, and create specific landscapes depending on what weathering process is dominant under a specific climate.		Earth Science
3.C.42	3.2	Describe how glaciers, gravity, wind, temperature changes, waves, and rivers cause weathering and erosion. Give examples of how the effects of these processes can be seen in our local environment.		Earth Science
3.C.43	3.3	Explain the nitrogen and carbon cycles and their roles in the improvement of soils for agriculture.		Earth Science
3.C.44	3.4	Describe the evolution of the atmosphere.		Earth Science
3.C.45	3.5	Describe how the oceans store carbon dioxide as dissolved HCO_3 and CaCO_3 precipitate.		Earth Science
3.C.46	3.6	Explain how water flows into and through a watershed, e.g., aquifers, wells, porosity, permeability, water table, capillary water, runoff.		Earth Science
3.C.47	3.7	Compare and contrast the processes of the hydrologic cycle including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.		Earth Science

3.C.48	3.8	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.		Earth Science
3.C.49		Describe influences and effects of toxic substances on living organisms (heavy metals, asbestos, formaldehyde, etc).		Voc
3.C.50		Explain the basic biological, chemical and physical properties that make up air and water pollution (acid rain, etc.) and describe their effects on the environment as a whole.		Voc
3.C.51		Identify major biotic and abiotic factors in the environment.		Voc
3.C.52		Distinguish between viruses and bacteria.		Voc
3.C.53		Explain the difference between anaerobic and aerobic processes.		Voc
3.C.54		Describe the flow of carbon and other factors in biosphere in regard to climate and biomass.		Voc
3.C.55		Distinguish between the two phosphorous cycles.		Voc
3.C.56		Explain the role of nutrients, soil, insecticides, pesticides, fertilizers, production demands, and land use on agriculture and renewable resources.		Voc
3.C.57		List and categorize major forms of solid waste.		Voc
3.C.58		Discuss water resource issues in light of human use, control, diversion, natural cycle and recharging.		Voc

Strand 4: Employability Knowledge and Skills

4.A Develop employability skills to secure and keep employment in chosen field.

- 4.A.01a Evaluate industries, organizations, and careers based on multiple sources of research and information.
- 4.A.02a Assess interest areas to determine potential career pathways, including career ladders.
- 4.A.03a Develop a career plan with alternatives.
- 4.A.04a Complete job applications and related employment documents (e.g. W-4).
- 4.A.05a Create professional cover letters, resumes, and portfolios in a variety of formats (print and electronic).
- 4.A.06a Apply job search skills to seek, evaluate, apply for, and accept employment.
- 4.A.07a Demonstrate good interviewing skills.
- 4.A.08a Demonstrate employability skills needed to get and keep a job.
- 4.A.09a Assess alternative occupational choices (e.g. working conditions, benefits, and opportunities to change).

Performance Examples:

1. Research positions open within a variety of companies and compare/contrast their descriptions, duties, and expectations.
2. Prepare responses to standard interview questions.
3. Participate in a mock-interview with industry professionals.

4.B Communicate in multiple modes to address needs within the career and technical field.

- 4.B.01a Apply strategies to enhance effectiveness of all types of communications in the workplace.
- 4.B.02a Apply reading skills and strategies to work-related documents.
- 4.B.03a Locate information from books, journals, magazines, and the Internet.
- 4.B.04a Apply basic writing skills to work-related communication.
- 4.B.05a Write work-related materials.
- 4.B.06a Explain information presented graphically.
- 4.B.07a Use writing/publishing/presentation applications.
- 4.B.08a Apply basic skills for work-related oral communication.
- 4.B.09a Explain proper telephone etiquette and skills.
- 4.B.10a Lead formal and informal group discussions.
- 4.B.11a Demonstrate effective negotiation and conflict management.
- 4.B.12a Apply active listening skills to obtain and clarify information.
- 4.B.13a Communicate with others in a diverse workforce.

Performance Examples:

1. Review a professional journal; choose one article to summarize.
2. Call the publisher for free products in journal.
3. Develop an oral presentation regarding an article in a journal.
4. Summarize trends presented in a graph.

4.C Solve problems using critical thinking.

- 4.C.01a Demonstrate skills used to define and analyze a given problem.
- 4.C.02a Explain the importance and dynamics of individual and teamwork approaches of problem solving.
- 4.C.03a Describe methods of researching and validating reliable information relevant to the problem.
- 4.C.04a Explain strategies used to formulate ideas, proposals and solutions to problems.
- 4.C.05a Select potential solutions based on reasoned criteria.
- 4.C.06a Implement and evaluate solution(s).

4.D Demonstrate positive work behaviors.

- 4.D.01a Identify time management and task prioritization skills.
- 4.D.02a Explain the importance of following workplace etiquette/protocol.
- 4.D.03a Demonstrate willingness to learn and further develop skills.
- 4.D.04a Demonstrate self-management skills.
- 4.D.05a List causes of stress and effective stress management techniques.
- 4.D.06a Describe the importance of having a positive attitude and techniques that boost morale.
- 4.D.07a Show initiative by coming up with unique solutions and taking on extra responsibilities.
- 4.D.08a Explain the importance of setting goals and demonstrate the ability to set, reach, and evaluate goals.
- 4.D.09a Explain the importance of taking pride in work accomplished and extrinsic and intrinsic motivators that can be used to increase pride.
- 4.D.10a Value the importance of professionalism, including reliability, honesty, responsibility, and ethics.
- 4.D.11a Demonstrate a respect for diversity and its benefit to the workplace.
- 4.D.12c Meet company attendance punctuality expectations.
- 4.D.13c Demonstrate effective negotiation skills.
- 4.D.14c Demonstrate conflict management with management/co-workers/others.
- 4.D.15c List the characteristics of a rational / responsible employee.

4.E Identify the standards and qualifications that must be met to pursue careers in Agriculture and Natural Resources.

- 4.E.01c Explain what types of skills or knowledge are necessary to work in a specific field of study.
- 4.E.02c Describe what type of degree or certification is required to enter a desired job/career.

Performance Example:

1. Student describes a career path progression including educational training, necessary work experience, and knowledge attainment to pursue careers within the Agriculture and Natural Resources Cluster, including the major career areas and examples of post-secondary opportunities.

Strand 5: Management and Entrepreneurship Knowledge and Skills

5.A Analyze basic business practices required to start and run a company/organization.

- 5.A.01a Define entrepreneurship.
- 5.A.02a Describe the relationship between suppliers, producers, and consumers.
- 5.A.03a Compare and contrast types of businesses, including sole proprietorships, small businesses, companies, corporations, governmental agencies, and non-profit organizations.
- 5.A.04a Describe practices that ensure quality customer service.
- 5.A.05a Explain the value of competition in business/field.

Performance Examples:

1. Prepare a business plan for a new company in your community.
2. Participate in a discussion with members of a local small-business incubator or chamber of commerce, identifying opportunities and summarizing best practices of new companies.
3. Create an equipment list, with costs, of equipment required for doing specific tasks.
4. Identify local zoning and environmental laws that apply to businesses in your industry.

5.B Manage all resources related to a business/organization.

- 5.B.01a Identify a company's/organization's chain of command and organizational structure.
- 5.B.02a Define and demonstrate leadership and teamwork skills.
- 5.B.03a Explain ways a company or organization can market itself, including choosing a name, designing logos and promotional materials, advertising, and the importance of word-of-mouth.
- 5.B.04a Identify methods to track inventory, productivity, income, expenses, and personnel .
- 5.B.05a Explain the importance of written operating procedures and policies.
- 5.B.06a Identify professional organizations and their benefits.
- 5.B.07a Explain methods to effectively run a meeting.

Performance Examples:

1. Create a plan to keep track of tools and supplies in your classroom/shop.
2. Work as a team to complete a project, including running and participating in problem-solving meetings.
3. Contact a relevant professional organization and request information about its benefits, membership requirements, and costs.
4. Clip print advertisements from local companies, identifying common themes and contrasting different styles.

5.C Describe methods for managing, organizing, retrieving and reporting financial data.

- 5.C.01a Explain the role of small businesses in the economy.
- 5.C.02a Extract and extrapolate data from financial documents, such as a pay-stub, budget, tax statement, and financial report.

Performance Examples:

1. Create and follow a budget for an in-class project.
2. Identify equipment in your shop/lab that are considered as capital.
3. From a pay-stub, determine gross salary, deductions, and net pay for a calendar year.
4. Create a rate card or other list of standardized costs for services provided, based on research of local rates and practices.

5.D Apply labor and civil rights law and guidelines to business practice and decisions.

- 5.D.01a List federal and state mandated employee rights.
- 5.D.02a Describe proper working conditions for your industry.
- 5.D.03a Explain the role of labor organizations.
- 5.D.04a Discuss the importance of diversity and list methods of encouraging diversity in the workplace.
- 5.D.05a Describe standard forms of employment contracts applicable to your industry.
- 5.D.06a State the current minimum wage, as well as wages for common jobs found within the field.
- 5.D.07a List opportunities for continual professional development.

Performance Examples:

1. Participate in and summarize a discussion with a member of a labor organization.
2. Participate in and summarize a discussion with a member of a civil rights organization.
3. While participating in a group project, write and follow job descriptions for each member of the team.
4. Evaluate a shop/lab in terms of safety, ergonomics, and workflow.

5.E Evaluate the effects of community relations on companies and the industry.

- 5.E.01a Describe the role that the industry/organization plays in different communities.
- 5.E.02a Describe the role that community interests play in a company's/organization's decision-making process.

Performance Example:

1. Participate in a service project or community-centered event.

5.F Apply legal requirements and ethical considerations to business practice and decisions.

- 5.F.01a Identify laws that regulate businesses/organizations in your field.
- 5.F.02a Define the requirements for and protections given by copyright and trademark law.
- 5.F.03a Define the impact of the Americans with Disabilities Act and other civil rights legislation on your business/organization, employees, and customers.
- 5.F.04a Define ethical business practices for your field.
- 5.F.05a Identify trade-specific practices that support clean energy technologies and encourage environmental sustainability.

Performance Examples:

1. Research the ethical guidelines set forth by a professional organization related to your industry and participate in a debate over how to apply these guidelines to a variety of situations.
2. Create a portfolio of a variety of completed contracts and their uses.
3. Participate in and summarize a discussion with a lawyer, consumer advocate, or other legal professional.
4. Create a quick reference outline listing legal topics and related resources.
5. Given a scenario involving the illegal or unethical activity of a co-worker or the employer, describe what steps would be taken to effectively remedy the situation.

5.G Demonstrate knowledge of ethical and legal issues as they related to the stewardship of natural resources.

- 5.G.01c Explain how personal responsibility and choices are related to natural resource sustainability.
- 5.G.02c Explain how personal workplace actions can affect the resource.
- 5.G.03c Identify sources for regulatory information.

Performance Example:

1. Describe examples of environmental impact by agricultural endeavors and the responsibility we have to minimize the impact, including some of the methods we have at our disposal to sustain our resources.

Strand 6: Technological Knowledge and Skills

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

- 6.A.01a Select and utilize the appropriate technology to solve a problem or complete a task.
- 6.A.02a Demonstrate file management skills (e.g., install new software, compress and expand files as needed, download files as appropriate).
- 6.A.03a Differentiate between different operating systems and demonstrate use of at least one to open and switch between programs and files.
- 6.A.04a Identify and demonstrate resolutions to simple hardware and software problems as they occur (e.g., frozen screen, disk error, printing problems).
- 6.A.05a Save, retrieve, load, format, and import data into, and export a variety of electronic documents (word processing, spreadsheet, database, AND desktop publishing).
- 6.A.06a Demonstrate the proper use of a variety of external peripherals and how they connect to a computer.
- 6.A.07a Illustrate methods of selecting and using search engines.
- 6.A.08a Send, receive, and manage electronic correspondence and files, in accordance with school policy.
- 6.A.09a Demonstrate proper use of electronic proofreading tools and explain reasons why these shouldn't be relied upon solely.
- 6.A.10c Perform efficient keyboarding techniques.
- 6.A.11c Demonstrate the use of formulas in a spreadsheet application.

Performance Example:

1. In the development of work-based projects, students demonstrate computer skills inherent in the word processing techniques used, the organization of data, use of photographic representation, research projects, and other relevant project based activities.

6.B Demonstrate responsible use of technology and an understanding of ethics and safety issues in using electronic media.

- 6.B.01a Identify ways in which technology is used in the workplace and in society.
- 6.B.02a Summarize the rights and responsibilities of the school's Acceptable Use Policy.
- 6.B.03a Explain laws restricting use of copyrighted materials on the Internet.
- 6.B.04a Discuss the concerns about electronic communications, privacy and security, including protection from spyware and viruses.

Performance Example:

1. Describe how computers are used to increase efficiency, accuracy, and professionalism in the industry.

6.C Demonstrate ability to use technology for research, problem solving, and communication.

- 6.C.01a Locate, evaluate, collect, and process information from a variety of electronic sources.

- 6.C.02a Demonstrate the use of telecommunications and other media to interact or collaborate with peers, experts, and other audiences.
- 6.C.03a Demonstrate the use of appropriate electronic sources to conduct research (e.g., Web sites, online periodical databases, and online catalogs).
- 6.C.04a Demonstrate proper style (with correct citations) when integrating electronic research results into a research project.
- 6.C.05a Collect, organize, analyze, and graphically present data using the most appropriate tools.
- 6.C.06a Present information, ideas, and results of work using any of a variety of communications technologies (e.g., multimedia presentations, Web pages, videotapes, desktop-published documents).
- 6.C.07a Identify capabilities of technology resources and describe how they can be used for lifelong learning.
- 6.C.08a Demonstrate the proper use of electronic tools and office communications equipment (telephone, fax, copier, etc).

Performance Example:

1. Student is able to effectively use various technologies in the workplace.