Massachusetts Career Technical Education Environmental Science and Technology

June 2014

DESE is in the process of updating all CTE Frameworks. This framework was adopted in 2014. More information about the process to update frameworks will be provided in DESE’s CCTE Newsletter.

# [Strand 2: Technical Knowledge and Skills](#_bookmark0)

##### Environmental Science Safety Health Knowledge and Skills

* + - * 1. Identify the need for and demonstrate the ability to perform CPR & First Aid as applied to the industry.

Demonstrate effective CPR as outlined by the American Heart Association.

Demonstrate the first aid skills outlined by the American Heart association for basic first aid.

* + 1. Performance Example:
       - Attain a CPR/First Aid Training Card/Credential.

##### Environmental Systems

* + - * 1. Explain concepts fundamental to Environmental Systems and society.

Define the major goals of Environmental Science.

Identify the major fields of study in the Environmental Sciences (e.g. biology, ecology, botany, forestry, earth science, physics, chemistry, and social science).

Distinguish among the roles of conservation, preservation and multiple use management practices.

Differentiate between renewable and non-renewable resources.

Explain the importance and role of biodiversity.

Define sustainability as it relates to the economy, environment and society (e.g. sustainable agriculture, aquaculture, environmental justice, and environmental ethics).

Explain the relationship between public health policy/politics and the environment.

Describe and assess the impact of invasive species on local ecosystems.

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.

* + 1. Performance Example:
       - Students conduct a field visit to a site (e.g. TTOR, 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.
         1. Explain concepts fundamental to the Hydrosphere.

Identify and describe the water cycle.

Diagram the connection between ground water and surface water.

Define an aquifer and elaborate on its ecological role.

Describe global water use and distribution.

Define water conservation and recommend implementation strategies.

Differentiate between point source vs. non-point source pollution.

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.
  + - * 1. Explain concepts fundamental to the Atmosphere.

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

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

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

Differentiate between weather and climate and the factors which affect them.

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

Identify and diagram the primary layers of the atmosphere.

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
    - * 1. Explain concepts fundamental to the Geosphere.

Identify the three major rock types and diagram the rock cycle.

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

Describe the concepts behind plate tectonics and continental drift theories.

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 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.
  + - * 1. Explain concepts fundamental to the Biosphere.

Identify and describe biotic and abiotic factors.

Define and explain the scientific principles of natural selection and evolution.

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.

##### Natural Resource Management

* + - * 1. Explain concepts fundamental to Aquatic Ecosystems.

Differentiate between various types of fresh water ecosystems (e.g. rivers, streams, lakes, and ponds).

Differentiate between various types of salt water ecosystems (e.g. estuaries, tide pools, brackish water, and salt marshes).

Define a watershed.

Illustrate and discuss pond succession.

Differentiate between natural and cultural eutrophication.

Diagram thermal stratification of a lake and elaborate on seasonal turnovers.

Collect aquatic organisms for study using appropriate equipment (e.g. Plankton Tows, D-Nets, Kick Seine).

Identify common aquatic organisms using field guides.

Identify common wetland types and elaborate on wetland functions (e.g. vernal pools, swamps, and bogs).

* + 1. 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.
         1. Explain concepts fundamental to Meteorology.

Identify the basic types of clouds and their associated weather patterns.

Interpret a weather map.

Analyze the role of the ocean on weather and climate.

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).

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.
  + - * 1. Demonstrate practices fundamental to Soil Science.

Identify basic soil particle sizes (e.g. sand, silt, clay, loam).

Diagram the soil horizons for a given site.

Conduct soil tests for pH, N, P, and K.

Describe factors that lead to soil erosion and determine soil conservation practices.

Utilize a given soil classification system (such as USDA or Unified Soil Classification System) for a given study site.

Explain the role of drainage class, porosity and permeability in the storage and transport of water.

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.
    - * 1. Demonstrate practices related to Wildlife Biology.

Define and cite examples of producers, consumers and decomposers in an ecosystem.

Distinguish between species as herbivores, carnivores or omnivores.

Diagram a food web for a local ecosystem.

Study wildlife populations using a variety of methods. (e.g. quadrat, line transect, mark recapture).

Summarize federal, state, and local wildlife regulations.

Describe types of evidence for the presence of common wildlife species.

Identify common New England wildlife species using field guides.

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.
  + - * 1. Demonstrate practices related to Forestry.

Identify common New England trees using a dichotomous key.

Define and diagram forest stratification and life zones.

Diagram and describe primary and secondary forest succession.

Measure the height and diameter of a tree and calculate the total board feet.

Measure the basal area of a tree.

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.

##### Mapping and Geospatial Analysis

* + - * 1. Navigate local terrain using industry practices and techniques.

Describe the technology of data acquisition through remote sensing.

Interpret topographic maps.

Utilize map coordinate systems.

Utilize a compass.

Utilize a Global Positioning System (GPS) Unit.

* + 1. 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.
         1. Utilize technologies and resources associated with effective land use planning.

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.

Determine and set the scale for the base map of a study area.

Import GPS waypoints into Geographic Information Systems (GIS) database from field studies.

Conduct natural resource inventories in forests, inland waters, and marine environments.

Propose best management practices for local areas (e.g. ecosystem management, watershed management, and storm water management).

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

* + - 1. **Environmental Technology Safety Health Knowledge and Skills**
         1. Complete the training for the 40-Hour OSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) certificate.

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.

* + 1. Performance Example:
       - Attain an OSHA HAZWOPPER certificate.
         1. Complete the training for a Permit-Required Confined Space certificate.

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.

##### Environmental Sampling & Laboratory Services

* + - * 1. Conduct environmental field sampling.

Keep records using field notebooks.

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

Collect and transport representative samples.

Perform preservation techniques and list materials required for specific sampling activities.

Prepare and follow Standard Operating Procedures.

Create a simulated Chain of Custody.

Sample using QA/QC procedures (e.g. replicates, equipment blanks and trip blanks).

Decontaminate equipment and tools used during sampling.

Test water quality using field test kits and assess water quality results.

* + 1. 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.
         1. Conduct environmental laboratory analysis.

Implement laboratory record keeping techniques for specific situations according to current industry standards.

Conduct microbiological testing (e.g. total coliform, fecal coliform).

Use, maintain and calibrate environmental bench top sampling meters (e.g. pH, DO, specific conductivity, and spectrophotometers).

Measure, contain, and mix substances using common laboratory equipment (e.g. balances, pipettes, volumetric flasks).

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.).

##### Energy Technologies and Sustainability

* + - * 1. Measure energy efficiency and explain its role in reducing air, water, and soil pollution.

Project energy saved through recycling a material and compare to pollution created without recycling.

Identify major sources of CO2 emissions.

Explain the benefits and costs of alternative energy sources that produce electricity (e.g. geothermal, nuclear, photovoltaic, wind, and biomass).

Assess the advantages and disadvantages of alternative fuels.

Specify the attributes of a Leadership in Energy and Environmental Design (LEED) certified building.

Diagram electricity distribution from plant production to end use (e.g. solar, coal, nuclear).

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.).

* + 1. 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.

##### Environmental Site Management

* + - * 1. Demonstrate practices related to hazardous-waste site assessment and remediation.

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.

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)).

Identify common sources of soil and groundwater contamination.

Identify common classes of chemicals of concern (petroleum products, chlorinated solvents, Volatile Organic Compounds (VOCs), Polychlorinated Biphenyls (PCBs), metals).

Describe drilling and sampling techniques used during environmental site assessments.

Determine up-gradient, down-gradient, and background conditions at a hazardous-waste site and determine appropriate sampling locations.

Conduct a jar-headspace test.

Conduct a field permeability test or bail-down test.

Measure depth to groundwater in an observation well using an electronic water-level meter and weighted steel tape and chalk.

* + - 1. Measure depth to oil and depth to groundwater using an oil-water interface probe.
      2. Convert depth to groundwater measurements to groundwater elevations.
      3. Create a map of the water table using groundwater-elevation measurements.
      4. Determine hydraulic gradient based on maps of the water table.
      5. Calculate groundwater velocity using permeability and hydraulic gradient data.
      6. Evaluate factors affecting fate, transport and remediation of chemicals in groundwater.
      7. Identify and recommend common soil and groundwater remediation systems given chemical and hydrogeologic setting.
      8. Interpret process and instrumentation diagrams (P&ID).
      9. Prepare a technical report from field data.
    1. 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.
         1. Demonstrate practices related to solid waste management.

Summarize federal and state laws governing waste management and landfill operations.

Identify the advantages and disadvantages of various solid-waste disposal options

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.

##### Applied Water Technologies

* + - * 1. Demonstrate practices related to Municipal Wastewater Treatment.

Explain the purpose and importance of wastewater treatment relative to public health.

Identify the sources of municipal wastewater and describe the importance of industrial pretreatment.

Describe the processes in a typical municipal wastewater treatment facility (e.g. preliminary, primary, secondary, advanced or tertiary, disinfection, and de-chlorination).

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).

Conduct laboratory procedures relating to wastewater treatment (e.g. coliform, DO, BOD, TSS, settleable solids, pH, and chlorine).

Explain local, state, and federal regulations relating to municipal wastewater treatment (e.g. Clean Water Act, NPDES Permit, 314 CMR, 310 CMR).

Identify career opportunities in wastewater treatment occupations and related credentials.

\* Identify the parts, functions and applications of pumps, valves, and other fluid-movement components of a wastewater-treatment plant.

\* Perform calculations used in municipal wastewater treatment (e.g. detention time, chemical dosage, % efficiency, flow, velocity, and water pressure).

* + - 1. \* Demonstrate proper operation and maintenance of mechanical equipment in a wastewater plant.
      2. \* Calculate the loading requirements for chemical dosing based on flow and concentration.
      3. \* Identify the most common chemicals used for coagulation, pH adjustment, disinfection, and de-chlorination, in typical treatment processes
      4. 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).

* + - * 1. Demonstrate practices related to Drinking Water Treatment.

Describe the purpose and importance of drinking-water treatment.

Identify sources of drinking water in Massachusetts and elaborate on the importance of water-supply protection (e.g. ground water and surface water).

Describe the processes used in a typical drinking water treatment facility (e.g. coagulation, flocculation, filtration, taste & odor control, disinfection, and fluoridation).

Conduct water sampling and collection (e.g. microbiological, lead, copper, organics, radiological).

Conduct laboratory procedures related to drinking water analysis and treatment (e.g. turbidity, chlorine, ammonia, iron, manganese, taste/odor, and algae/bacteria).

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).

Identify career opportunities in drinking water occupations and related credentials.

\* Define a public water supply system, and the regulatory requirements and administrative responsibilities of a public water supply provider.

\* Identify the parts, functions, and applications of pumps, valves, and other fluid-movement components of a drinking-water treatment plant.

* + - 1. \* Demonstrate proper operation and maintenance of mechanical equipment in a drinking-water plant.
      2. \* Compare and contrast the differences among the physical, chemical, and biological properties of groundwater vs. surface water sources.
      3. \* Calculate the loading requirements for chemical dosings based on flow and concentration.
      4. \* Perform safety and security measures related to protection of public drinking-water supplies.
      5. \* Identify the most common chemicals used for coagulation, pH adjustment, disinfection, fluoridation, in typical treatment processes.
      6. \* 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).
      7. 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

* + - 1. **Safety Health Knowledge and Skills**
         1. Use outdoor equipment associated with the industry.

Set up/adjust at least one type of tent.

Describe important points in selecting and fitting a backpack.

Light a pack stove and boil 2 cups of water using safe fire practices.

Tie six common knots (e.g. bowline, taughtline, sheetbend, clovehitch, cleathitch, timberhitch).

Maintain and store equipment following manufacturers’ recommendations and industry standards.

* + 1. 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.
         1. Demonstrate concepts fundamental to outdoor safety.

Identify weather-related dangers.

Identify hazards as they relate to terrain.

Identify poisonous and dangerous plants and animals.

Identify hazardous situations at the work location.

Demonstrate hazard mitigation techniques.

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

Dress properly for a variety of working/weather conditions.

* + - * 1. Demonstrate skills fundamental to water safety.

Describe issues related to safety around water.

Use waders.

Complete Massachusetts Boaters Safety Course.

Demonstrate the safe use of kayaks and canoes.

2.J.03 Performance Example:

* Attain Massachusetts Boater’s Safety Certification

##### 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.

* + - 1. \* Describe the relationships between minimal sample size, standard deviation and probability.
      2. \* Explain the importance of statistical significance. 2.K.01.07\* Explain the importance of a random sample.
      3. \* Differentiate between a scientific paper and a lay article.
      4. \* Identify the components of a scientific paper and the purposes of each. 2.K.01.10\* Demonstrate proper citation.
    1. 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. Demonstrate an understanding of Natural Resource Policy and Administration.
       1. Explain the concept of multiple-use management.
       2. Identify government agencies involved in inland fisheries management.
       3. Identify government agencies involved in marine fisheries management.
       4. Identify government agencies involved in forestry management and explain their role.
       5. Identify government agencies involved in outdoor recreation management and explain their role.
       6. Identify government agencies involved in wildlife management and explain their role.
       7. Describe the role of municipal conservation commissions.
       8. 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.
  + 1. Describe practices related to outdoor public safety.
       1. Demonstrate recreation area safety enhancement techniques.
       2. Identify impacts by humans on natural resources.
       3. Conduct resource inventory and population studies.
       4. Demonstrate appropriate techniques and use of equipment when working with bio-hazards according to current industry and OSHA standards..
       5. Describe law enforcement procedures used to manage public gatherings and to gain entry into secure, closed or restricted areas.
       6. Describe precautions to use when interfacing with the public concerning regulations and law enforcement.
       7. Describe security issues for closed and restricted areas.
       8. Describe solutions to issues concerning public protection.
       9. Identify appropriate law enforcement authorities relating to natural resources spaces.

2.K.03.10 Explain how public recreation use is a product.

2.K.04 Performance Example:

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

2.K.03 Performance Example:

* Perform a site safety assessment at a local public property (e.g. TTOR, DCR, Local Land Trust)

identifying:

o Poisonous plants

o Potentially hazardous terrain/objects

o Possible mitigation practices to improve public safety

* + 1. Complete the Certified Interpretive Guide (CIG) training course offered by the National Association of Interpretation (NAI).

##### Environmental Sampling & Laboratory Services

* + - * 1. Conduct environmental field sampling.

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

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

Collect and transport representative samples using industry procedures and safety precautions.

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

Prepare and follow Standard Operating Procedures.

* + 1. 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.
         1. Conduct environmental laboratory analysis.

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.

##### Ecology

* + - * 1. Explain concepts fundamental to ecological cycles.

Diagram the nitrogen cycle.

Describe the carbon cycle.

Diagram a trophic pyramid.

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

* + 1. Performance Example:
       - Diagram a trophic pyramid for a given ecosystem identifying symbiotic relationships that exist.
         1. Demonstrate an understanding of population dynamics.

Describe population dynamics.

Describe predator-prey relationships.

Explain the relationship between harvest levels and resource sustainability.

Distinguish between populations, communities and ecosystems.

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.
  + - * 1. Explain concepts and practices related to invasive species management.

Identify common and potentially invasive species.

Distinguish between introduced and invasive species.

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

Treat for invasive species infestation, using substitutions where appropriate.

Describe how to report observance of infestations.

Measure, mix, and apply a recommended chemical for control of a specific pest (e.g. using simulations where appropriate).

Discuss the pros, cons, and procedures of integrated pest management.

Identify and manually remove invasive plants using recommended procedures.

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.

##### Wildlife & Fisheries Biology

* + - * 1. Demonstrate techniques related to wildlife management.

Demonstrate wildlife habitat enhancement techniques.

Describe wildlife harvest techniques and procedures.

Distinguish between commercial, subsistence, and recreational use and their relationship to wildlife management.

Use Radio Telemetry with and without triangulation.

Use a variety of measuring devices (digital balance, spring scale, calipers etc.).

Demonstrate the safe capture and handling of a variety of species utilizing different tools.

* + 1. Performance Example:
       - Utilize a radio telemetry receiver to triangulate the position of a transmitter randomly placed in the field.
         1. Demonstrate an understanding of fisheries biology.

Identify fish species common to New England.

Define fisheries and differentiate consumptive and non-consumptive uses (commercial, subsistence, and recreational).

Compare fishery management strategies with consumptive and non- consumptive uses.

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.
    - * 1. Demonstrate fisheries management techniques.

Demonstrate stream/pond enhancement techniques.

Describe fish harvest techniques and procedures.

Measure specimens using a fish board.

Use a haul seine.

Explain the use of a backpack and boat mounted electroshocking equipment for fisheries surveys.

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.

* + - 1. \* List six occupations in aquaculture.
      2. \* Explain how species requirements will affect aquaculture system design and management.
      3. \* Distinguish between recirculating, flow-through and open systems. 2.N.04.04\* Explain the fundamentals of filtration and biofiltration.
      4. \* Define polyculture and give an example.
      5. \* 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.

* + - 1. \* Perform all required water quality tests and explain the significance of the results.
      2. \* Outline sound fish health management practices. 2.N.05.03\* Clean and maintain a filter system.
      3. \* Prepare a saltwater solution.
      4. \* 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.

##### Forest Conservation

* + - * 1. Demonstrate an understanding of Botany.

Define and explain the relationship between respiration, transpiration and photosynthesis.

Define and explain nutrition and fertilization.

Identify and describe plant anatomy.

Distinguish between sexual and asexual plant reproduction.

Describe the effects of soil structure and texture on plant anatomy and physiology.

Distinguish monocots from dicots.

Distinguish angiosperms from gymnosperms.

List the rules for plant nomenclature.

* + 1. Performance Example:
       - Correctly diagram the major anatomical features of a plant and identify their significance.
         1. Identify a variety of plants common to the New England region.

Give common and scientific names for plants.

Demonstrate the use of a key or reference guide to identify plants.

Identify woody and herbaceous plant species common to a geographical region.

Identify plants used as habitat indicators (wetlands, uplands, sand plain etc.).

2.O.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.
    - * 1. Explain concepts and demonstrate techniques fundamental to Forestry

Use a chainsaw following manufacturers’ and industry safety procedures.

Maintain a chainsaw.

Explain the use of different forestry equipment (e.g. skidder, tree sheer).

Determine forest stand improvement techniques appropriate for a given site.

Describe forest harvest techniques and procedures.

Identify techniques and equipment needed to prevent wildfire.

Follow personal fire prevention precautions while working in natural environments.

2.O.04\* Define concepts fundamental to wetlands delineation and protection. 2.O.04.01\* List and explain the characteristics of wetland plants.

2.O.04.02\* List and explain the five wetland species indicator categories and identify common species of each.

2.O.04.03\* Compare and contrast submergent, emergent and floating vegetation. 2.O.04.04\* Diagram a wetland including litoral, limnetic, and aphotic zones.

2.O.04.05\* Delineate a wetland including the vegetative buffer zone.

2.O.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.

* + - 1. \* Identify the major ocean basins.
      2. \* Define the characteristics of sea water and its effects.
      3. \* Diagram the environmental conditions associated with the supratidal, intertidal, and subtidal zones.
      4. \* 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.

* + 1. 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.

* + - 1. \* Diagram a marine food chain from primary producer through tertiary consumer.
      2. \* Describe the two most important factors that determine where coral reefs develop.
      3. \* Identify common marine reptiles, birds and mammals.
      4. \* Compare and contrast the productivity differences between polar, tropical, and temperate waters.
      5. \* Describe the features of the following ecosystems: estuarine, coral reefs, sandy beach, and rocky shore.
      6. \* 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.

# [Embedded Academic Crosswalks](#_bookmark0)

## [Embedded English Language Arts and Literacy](#_bookmark0)

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| 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: | * 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: | * 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: | * 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: | * 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: | * 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. |

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| Performance Example:   * 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. |
| Performance Example: |  | 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. |
| Performance Example: | * 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. |
| Performance Example: | * 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. |
| Performance Example: | * 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](#_bookmark0)

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| 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.  |
| Performance Example: |  | * 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.  |
| Performance Example:   * 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). |
| Performance Example:   * 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.  |
| Performance Example:   * 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.  |
| 2.C.01.08 | N-VM.6 | Perform operations on matrices and use matrices in applications. (+) Use matrices to represent and manipulate data. |
| Performance Example:   * Students perform a population study of Atlantic Silverside fish (Menidia menidia) 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.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line*  *parallel to a given line through a point not on the line.* |
| Performance Example:   * 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. *For example,*  *rearrange Ohm’s law V = IR to highlight resistance R.*  |
| Performance Example: | * 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. |

## [Embedded Science and Technology/Engineering](#_bookmark0)

### [Earth and Space Science](#_bookmark0)

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| 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). |
| Performance Example:   * 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). |
| Performance Example:   * 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. |
| Performance Example:   * 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. |
| Performance Example:   * 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. |

### [Life Science (Biology)](#_bookmark0)

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| 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. |
| Performance Example: | * 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 indentify 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. |
| Performance Example:   * Choose three locations around the school to assess the level of habitat destruction and develop a plan to minimize habitat loss :   + Assess the loss of habitat, and explain the process. | * + Investigate/describe the effect human development has on habitats.   + Recommend measures to balance human inhabitance and habitat preservation. * Explore how overfishing could cause quick evolutionary change: | * + Investigate the effects of overfishing on fish populations.   + Gather data and analyze it.   + Draw conclusions on evolutionary changes. |
| 2.C.04.01 | 6.3 | Use a food web to identify and distinguish producers, consumers, |
| 2.C.04.02 |  | and decomposers, and explain the transfer of energy through tropic |
| 2.C.04.03 |  | levels. Describe how relationships among organisms ( predation, |
| 2.M.01.04 |  | parasitism, competition, commensalism, and mutualism) add to the complexity of biological communities. |
| Performance Example:   * Study a pond food web: | * + 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 | 6.4 | Explain how water, carbon, and nitrogen cycle between abiotic |
| 2.M.01.01 |  | resources and organic matter in an ecosystem, and how oxygen |
| 2.M.01.02 |  | cycles through photosynthesis and respiration. |
| Performance Example: | * 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 | 5.3 | Explain how evolution through natural selection can result in |
| 2.B.05.03 |  | changes in biodiversity through the increase or decrease of genetic |
|  |  | diversity within a population. |
| Performance Example: | * 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 date to introduce | frequency and biodiversity indices. (e.g. Shannon-Weiner). |
| 2.M.02.01 | 6.1 | Explain how birth, death, immigration, and emigration influence |
| 2.M.02.02  2.M.02.04 |  | population size. |
| Performance Example: | * 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. |
| Performance example: | * 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. |
| Performance Example: | * 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)](#_bookmark0)

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| 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: | * 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: | * 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: | * 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: | * 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: | * 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: | * 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 |

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| Performance Example: | 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: | * Collect samples of water from a local pond to test for 5-day biochemical oxygen demand and turbidity. |  |

### [Physical Science (Physics)](#_bookmark0)

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| 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: | * 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: | * Conduct a home energy survey, calculating daily, monthly, and yearly power demands. |  |

[Industry Recognized Credentials](#_bookmark0) (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.

1. Massachusetts Boater’s Safety \* MA Environmental Police
2. Life Guard \*

American Red Cross or BSA

1. SCUBA (Open water I) \* NAUI or PADI or SSI
2. Massachusetts Hunter Education \* MA Div. Fisheries & Wildlife
3. Massachusetts Trapper Education MA Div. Fisheries & Wildlife
4. Massachusetts Problem Animal Control MA Div. Fisheries & Wildlife
5. Certified Timber Harvester MA Dept. Cons. & Recreation
6. Certified Interpretive Guide \*

National Association for Interpretation

1. Marine Safety Training

Marine Safety Consultants, Inc. or SMAST

1. Seasonal Conservation Law Enforcement Training Association of National Park Rangers
2. 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

1. OSHA Permit-Required Confined Space Certificate\* OSHA Permit-Required Confined Space Publication 3138

OSHA Permit-Required Confined Space Std. 1910.146

1. OSHA Disaster Site Worker Card/Credential

OSHA Disaster Site Worker Program Requirements

1. Certified Operator of a Drinking Water Supply Facility

MA Board of Certification of Operators of Drinking Water Supply Facilities

1. Wastewater Operator Certification (17 yr old students eligible) MA DEP Wastewater Operator Certification
2. Sustainability 101 Certificate\*

Green Education Foundation Institute

\*Can be earned by student prior to graduation