Massachusetts Career Technical Education

Agricultural Mechanics Framework

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)

###### Agricultural Mechanics Safety Health Knowledge and Skills

* + 1. Identify and follow safety practices and procedures according to current industry and OSHA standards.
       1. Explain the importance of OSHA in providing a safe and healthy workplace for workers.
       2. Describe appropriate action in case of fire, accident, or other emergency.
       3. Identify and reduce hazards in the workplace and work environment.
       4. Select and use personal protective equipment (PPE).
    2. Performance Example:
       - Sketch a floor plan of the shop area indicating the location of safety equipment. (e.g., fire blanket, fire extinguisher, eye wash, flammable storage, first aid kit, etc.) Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint.
    3. Follow OSHA precautions associated with the Four High Hazards (falls, electrocution, struck-by (e.g. falling objects, trucks, and cranes) and caught-in or between (e.g. equipment, vehicles, and trench hazards).
       1. Identify major hazards.
       2. Describe types of hazards.
       3. Identify methods of protection from hazards.
       4. Identify employer requirements to protect workers from hazards.

2.A.02 Performance Example:

* Participate in the 10-hour OSHA training and successfully earn a certificate.
  + 1. Select and use the appropriate tool to perform a given task.
       1. Select tools and equipment.
       2. Use tools and equipment safely, following OSHA guidelines and industry standards.
       3. Set up, maintain and adjust tools and equipment following manufacturer’s operating instructions.
       4. Store tools according to manufacturer’s specifications and industry standards.

2.A.03 Performance Example:

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

###### Agricultural Machinery and Equipment

* + 1. Operate agricultural equipment including tractors.
       1. Explain all safety precautions for specific equipment prior to use.
       2. Perform pre- and post-trip inspection.
       3. Start, stop, and operate a tractor and/or other agricultural equipment.
       4. Identify and use common ASAE hand signals to communicate on the job site.
    2. Performance Example:
       - Complete assigned reading related to the maintenance, repair and operation of a tractor or piece of equipment. Students will participate in classroom instruction on these topics and complete assignments on each of the components involved in safe operation. Once a student has mastered the individual skills, they will work as a team to perform preventive maintenance service on a tractor or piece of equipment then operate a tractor.
    3. Attach implement(s) to a tractor.
       1. Make hitch and PTO adjustments.
       2. Establish ballast and tire pressure.
       3. Adjust wheel tread spacing.

2.B.02 Performance Example:

* After thorough reading of related text and equipment manual students will attach an implement to a tractor.
* Using the tire manufacturer’s and operator’s manuals,, the students will set tire pressure to specifications and explain the effects which ambient and tire temperature have on tire pressure.
  + 1. Prepare equipment for winter storage.
       1. Lubricate and clean equipment prior to winter storage.
       2. Protect equipment for storage in cold climates (below freezing).

2.B.03 Performance Example:

* Students prepare a piece of equipment for storage following recommended procedure in the operator’s manual.
  + 1. Select fuels, coolants, lubricants and hydraulic fluids for tractors, machinery and equipment.
       1. Identify appropriate use of “on and off” fluids.
       2. Identify different types of hydraulic oils.
       3. Identify different types of motor oils.
       4. Identify different types of antifreeze.
       5. Identify different gear oils and greases.

2.B.04 Performance Example:

* Students will refer to service and repair manuals to determine the engine’s oil capacity and select the correct grade and type needed. (e.g., 15w40 ca for compression-ignition, synthetic etc.).
  + 1. Identify and replace air induction system components.
       1. Identify all parts of an intake system.
       2. Service a wet type air filter.
       3. Explain function of a turbocharger.
       4. Explain function of a charge air cooler.

2.B.05 Performance Example:

* Students identify the parts of a turbocharger in a break down example and explain in writing how the turbocharger operates, including what happens to the combustion air while going through it. Based on observations and background reading, students write a position paper regarding the advantages of cooling the air before it reaches the combustion chamber.
  + 1. Identify and service cooling system components.
       1. Identify and explain parts of an air cooled system.
       2. Identify and explain parts of a liquid cooled system.
       3. Describe the different types of antifreeze.
       4. Check and inspect a cooling system.
       5. Test and set freeze protection.
       6. Explain the use of diesel coolant additives (DCA).

2.B.06 Performance Example:

* Students develop a presentation on how a liquid cooling system operates. The presentation will include a one page overview with key features of a liquid cooling system, reference dictionary of terms, and visual diagram (or animated media component). The presentation will include a demonstration of how to accurately calculate fluid ratios.
  + 1. List and explain the function of components in the fuel system.
       1. Identify types of fuel systems.
       2. Describe the purpose of and diagram the components of carburetor and fuel injection systems.
       3. Describe the different types of fuel pumps.

2.B.07 Performance Example:

* When given a parts breakdown, student will identify parts of the carburetor.
  + 1. Identify and service hydraulic system components.
       1. Identify major system components.
       2. Identify types of hydraulic pumps.
       3. Describe basic hydraulic principle.
       4. Test, adjust and repair a hydraulic system.

2.B.08 Performance Example:

* Student will make a replacement hydraulic hose for a given piece of hydraulic equipment by measuring the length of hose and determining the diameter needed as well as selecting the appropriate size & type of fittings necessary to complete the assembly.
  + 1. Demonstrate the operation and service of a transmission and clutch.
       1. List the functions and types of transmissions.
       2. Identify different types of clutches.
       3. Service and adjust a transmission and clutch.

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

2.B.09 Performance Example:

* When given the service manual for a large tractor or truck, students will adjust the clutch and pedal-free-travel to specifications.
  + - 1. Describe electrical principle.
      2. Identify types of batteries.
      3. List the principles of alternators and generators.
      4. Explain the function of a starter motor.
      5. Repair an ignition system.
      6. Diagnose and replace electrical system components.
      7. Troubleshoot and repair components within an electrical system.

2.B.10 Performance Example:

* Using safety procedures, students will load test a 12 volt battery and determine if it is good to use or needs to be replaced.
* Given the repair manual for a large multi cylinder gasoline engine, students will select the proper tools, determine the firing order, install the distributor correctly in the engine, and set ignition timing to specifications.
  + 1. Operate gasoline and diesel engines.
       1. Describe 2 and 4 stroke operating principles.
       2. List and diagram the major internal parts of gas and diesel engines.
       3. Select and use measuring tools when replacing or reinstalling parts.
       4. Select and use hand tools to complete a repair or maintenance task on a gas or diesel engine.
       5. Disassemble and assemble a (small or large) gas engine.
       6. Disassemble and assemble a (small or large) diesel engine.
       7. Diagnose, repair, adjust or replace engine parts.

2.B.11 Performance Example:

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

Bore = 4.00”

Stroke = 3.48”

Cylinders = 8

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

Stroke = 3.48

Pi = 3.14

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

###### Construction, Repair, and Maintenance

* + 1. Perform various basic carpentry tasks associated with the agricultural mechanics field.
       1. Identify building materials and describe their applications.
       2. Read and interpret construction blueprints, working drawings, and building codes.
       3. Estimate needs, costs, and quantity of building materials.
       4. Perform carpentry math calculations.
       5. Measure and layout a related carpentry task.
       6. Store lumber and other carpentry materials for future use.
       7. Check structures for square, plumb, and level.
       8. Select and install fasteners and hardware as appropriate for the task at hand.
       9. \* Describe lumber grading and marking systems.
    2. Performance Example:
       - Assign students, in groups, a project to build a storage unit for agricultural equipment. The student groups will have a selection of three to four different models for a shed (e.g., gambrel,

½ shed, barn). Each group is responsible for creating a supply list, pricing out the materials, and constructing the shed. Students will have a set budget and other constraints provided by the ‘customer’ (being the teacher). Throughout the project, students will apply measuring, material selection and carpentry skills.

* + 1. Use hand and power tools commonly utilized in agricultural mechanics.
       1. Select the appropriate tool for a task.
       2. Use and maintain fastening, clamping, and dismantling tools (e.g., bench clamps, pneumatic nail gun).
       3. Use and maintain sawing tools (e.g., circular saw, table saw, reciprocating saw, power miter saw, radial arm saw).
       4. Use and maintain drilling and boring tools (e.g., portable drill, drill press).
       5. Use and maintain planing, smoothing, and shaping tools (e.g., power sanders, planers, routers, scrapers).
       6. \* Use and maintain levels (e.g., spirit, rotary laser)

2.C.02 Performance Example:

* Following the specifications from the operating materials (and demonstrations) students create a “Circular Saw Procedures Manual” describing the procedures and steps necessary to use a circular saw safely and efficiently. Students will then present their manual to other students who will determine if the manual is sufficient for operation of a circular saw. Based on feedback from the group, the students will edit and revise their manual.
* Independently, each student will build a sawhorse using the skills developed throughout the unit. Sawhorses require angle and strength considerations. The completed sawhorses will be used throughout the course. Students will use saws, fasters (screws/nails) and other required tools.
  + 1. Demonstrate skills necessary for building construction, repair, and maintenance.
       1. Identify structural components of a building.
       2. Select materials, layout, and cut structural components of a building.
       3. Identify various siding materials and describe their applications.
       4. Demonstrate installation methods for siding materials.
       5. Identify various roofing materials and describe their applications.
       6. Demonstrate installation methods for roofing materials.
       7. Identify tools used for concrete work.
       8. Determine quantity and cost of concrete.
       9. Prepare forms for concrete.
       10. Mix, place, finish, and cure concrete.
       11. Prepare surfaces for finish application.
       12. Apply paint and other finishing materials.
       13. Demonstrate use and maintenance of extension and step ladders.
       14. Describe various sources of energy, including renewable, and sustainable

practices for construction in agricultural mechanics.

* + - 1. \* Identify environmental concerns and methods for reduced impact in construction and design of agricultural construction.
      2. \* Demonstrate use and maintenance of pump-jack staging and wall brackets. 2.C.03.17\* Demonstrate use and maintenance of roof brackets.
      3. \* Install windows and exterior doors.
      4. \* Explain the reason for building codes and describe the different types of work governed by each code.
      5. \* Layout and cut rough stairs. 2.C.03.21\* Layout and cut a common rafter.
      6. \* Identify various framing methods and terms (e.g. gable, hip, truss, balloon, and platform).
      7. \* Explain code requirements for insulation and vapor barriers.

2.C.03 Performance Example:

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

###### Metal Work

* + 1. Perform a variety of welding skills including arc welding, plasma cutting, gas welding, and gas cutting.
       1. Select and prepare materials, tools and equipment for welding and cutting based on the task at hand.
       2. Identify and follow safety practices used in welding and cutting.
       3. Set-up, start up, shutdown and secure welding and cutting equipment.
       4. Layout and prepare metal for welding and/or cutting.
       5. Control for distortion in arc welding.
       6. Weld basic joints using SMAW, GMAW, GTAW and FCAW.
       7. Cut mild steel, including pipe. 2.D.01.08\* Braze weld basic joints.

2.D.01.09\* Weld basic joints out of position (i.e., vertical, horizontal, overhead) using SMAW, GMAW.

* + - 1. \* Select and apply hard surfacing materials/alloys.
    1. Performance Example:
       - After unit lessons on each of the welding techniques and practice sessions to gain both confidence and form, students will repair or assemble a piece of agricultural equipment out of metal. Students may select to create a blade for a trowel or hoe, or repair a loose piece. Once the pieces are completed, members of the advisory board will come in to evaluate the repair/design of the finished metal work. The work will be evaluated on quality of work and effective use of the different welding techniques. Students will include a one page written document on the process they used and why they used the techniques they did, including safety considerations for both the process and the final product.
       - The student will demonstrate a step-by-step procedure for the recommended method of checking for leaks in gas welding equipment.
       - When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat.
       - When given a plan and the appropriate tools and materials, the student will properly cut pipe of mild steel.
       1. \* Read metal working plans, prints, drawings and welding symbols. 2.D.01.12\* Estimate and calculate welding and cutting materials costs.
    2. Manipulate hot and cold metal.
       1. Identify various types and shapes of metal.
       2. Select appropriate materials, tools and equipment for hot and cold metal working.
       3. Select soldering equipment and supplies.
       4. Prepare and solder copper joints.
       5. Prepare and solder electrical connections.
       6. Join metals with appropriate fasteners.
       7. Determine tap and drill sizes.
       8. Layout and drill holes with a twist drill.
       9. Repair damaged threads.

2.D.02.10\* Cut threads with taps and dies, to meet given specifications.

2.D.02.11\* Select appropriate metals for projects (strength).

2.D.02.12\* Select appropriate abrasives for grinding and sharpening.

2.D.02.13\* Set-up and prepare grinding and sharpening equipment.

2.D.02.14\* Recondition chainsaw, horticultural and turf cutting tools.

2.D.02.15\* Recondition rotary lawn mower blades.

2.D.02 Performance Example:

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

###### Irrigation Systems

* + 1. Explain concepts fundamental to irrigation systems.
       1. Compare and contrast different irrigation systems based on the benefits and costs of the different technologies and methods used.
       2. Select an irrigation system for a specific climate and need.
       3. List cost factors involved with irrigation systems for a variety of scenarios and applications.
       4. Identify the impact that natural occurrences such as erosion, weathering, etc. can have on an irrigation system.
       5. \* Summarize the environmental protection regulations that must be considered when developing an irrigation system.
    2. Performance Example:
       - Students will choose a land area (yard, athletic field, golf course, etc.) and perform an analysis on that land area where they discuss the pros and cons of 3 different kinds of irrigation systems.
    3. Demonstrate plumbing skills necessary to fabricate/maintain an irrigation system.
       1. Identify jobs requiring a licensed plumber.
       2. Describe the different types of pipes and fittings.
       3. Select appropriate pipe threading and cutting tools based on the irrigation model selected.
       4. Cut and assemble plastic pipe to given specifications.
       5. Cut and assemble steel pipe to given specifications.
       6. Connect flare and compression fittings.
       7. Solder copper fittings.

2.E.02 Performance Example:

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

###### NOTES:

\* indicates supplemental/advanced learning standards and objectives.

# [Strand 3: Embedded Academics](#_bookmark0)

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

|  |  |  |
| --- | --- | --- |
| Framework  Learning Standard Number | Strand Coding Designation Grades ELAs Learning Standard Number | Text of English Language Arts Learning Standard |
| 2.A.01.01 | RST grades 9-10 #1,4,5 | 1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.  4. Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in specific scientific or technical context relevant to grade 9-10 texts and topics.  5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g. force, friction, reaction force, energy).  Performance Example:   * Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint. |
| 2.A.01.01 | WHST grades 9-10 #4,10 | 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single setting or a day or  two) for a range of discipline-specific tasks, purposes, and audiences.  Performance Example:   * Given a prepared text of a shop safety hazard scenario complete with technical vocabulary and terms, the student will determine what information should be used to complete a standard OSHA complaint form and will then accurately complete the written complaint. |
| 2.A.01.03 | WHST grades 9-10 #4,5,7,10 | 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.  7. Conduct short as well as more sustained research projects to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.  10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single setting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.  Performance Example:   * Students will describe, through oral and written presentation, proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources. |
| 2.A.01.03 | SL grades 9-10 #1(a-d) | Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics*, *texts*, *and issues*, building on others’ ideas and expressing their own clearly and persuasively.  Performance Example:   * Students will describe, through oral and written presentation, proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources. |
| 2.A.02.02 | RST 1,2,3,4,7 | 1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 2. Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.   7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.  Performance Example:  Given a power tool and the manufacturer’s operator’s manual with included diagrams and other visual supports as a reference, the student will determine and verify by making a check list, if all guards and other safety devices are in place and in proper working condition. |
| Numerous VTEF  standards related | WHST grades 9-10 # 2(a-f), 4,5,9  RST grades 9-10, #3,4 | 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  9. Draw evidence from informational texts to support analysis, reflection, and research.  3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  4. Determine the meaning of symbols, key terms, and other domain-  specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.  Performance Example:   * Students will complete a multi step research and writing project on irrigation systems. This will include reading a variety of text focusing on the types and components of irrigation systems, documenting key factors from text, synthesizing the information collected and organizing materials into a written document presenting strategies and considerations for selecting an irrigation system for different types of agricultural   or environmental projects (problems). Students will be expected to cite references, edit and revise. |
| 2.B.02 | RST grades 9-10, #3,4 | 1. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text   Determine the meaning of symbols, key terms, and other domain- specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. |
|  |  | Performance Examples:   * After thorough reading of related text and equipment manual, students will safely and correctly attach an implement to a tractor. * After thorough reading of related text and participating in class instruction/demonstration, students will perform preventive maintenance service on a tractor/ equipment and students will demonstrate the safe   operation of a tractor. |
| 2.B.02.02 | RST grades 9-10, #3,7 | 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate  information expressed visually or mathematically (e.g., in an equation) into words. |
|  |  | Performance Example:  Students will refer to the tire manufacturer/operator’s manual and set tire pressure to specifications and also explain what effect ambient and tire temperature have on tire pressure. |
| 2.B.03.01 | RST grades 9-10, #3 | 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical  tasks, attending to special cases or exceptions defined in the text. |
|  |  | Performance Example:  For a given piece of equipment, students will follow recommended procedure in the operator’s manual to prepare it for storage. |
| 2.B.05.03-  2.B.05.04 | WHST grades 9-10, # 1 (a-e) | 1. Write arguments focused on *discipline-specific content*. |
|  |  | Performance Example:   * When given a breakdown, students will identify the parts of a turbocharger and also explain in writing, how the turbocharger operates and what happens to the combustion air while going through it. The students will also write a claim to identify the advantages of cooling the air before it reaches the combustion chamber. |
| 2.B.06.02-  2.B.06.06 | WHST grades 9-10 #2a,b,d | 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. |
|  |  | Performance Example:  Students will explain in writing, using appropriate technical terms, how a liquid cooling system operates. This will include a description of the major components and an explanation of how the liquid can function in extreme cold without freezing and extreme heat without boiling. Given a cooling system’s total capacity, students will figure the amount of antifreeze needed for 60% mixture and 40% water for proper freeze protection. |
| 2.B.09.03 | SL grades 9-10, #1a-d, #4 | 1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics*, *texts*, *and issues*, building on others’ ideas and expressing their own clearly and persuasively.  4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style  are appropriate to purpose, audience, and task. |
|  |  | Performance Example:   * Students will refer to service manual for proper clutch adjustment procedure, and explain in an oral   presentation why it is important to maintain proper adjustment and what the function of the clutch is in the driveline. |
| 2.B.11 .01-  2.B.11.06 | SL grades 9-10, #1 a-d, #4 | 1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics*, *texts*, *and issues*, building on others’ ideas and expressing their own clearly and persuasively.  4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. |
|  |  | Performance Example:   * Using the service manual students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke   along with the number of cylinders, students will calculate the engines displacement. |
| 2.B.11.01-  2.B.11.06 | RST grades 9-10, #3, 4 | 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.  4. Determine the meaning of symbols, key terms, and other domain- specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. |
| 2.B.01.02-  2.B.02.03 | SL grades 11-12, #4 | 4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal  and informal tasks. |
|  |  | Performance Example:   * Using the service manual students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke   along with the number of cylinders students will calculate the engines displacement. |
| 2.C.02.03 | WHST grades 9-10 # 2a-f, 4,5,9 | 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  9. Draw evidence from informational texts to support analysis, reflection, and research. |
|  |  | Performance Example:   * Students will be provided with a manufacturer’s manual for a particular circular saw. Using the manual,   students will create a “Circular Saw Procedures Manual” that will describe and list all the procedures and steps necessary to use a circular saw safely and efficiently. |
| 2.D.01.04-  2.D.01.06 | RST grades 9-10, # 3,4 | 1. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 2. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific   scientific or technical context relevant to grades 9–10 texts and topics. |
|  |  | Performance Example:  When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat. |
| 2.D.01.08 | RST grades 9-10, #9 | 9. Compare and contrast findings presented in a text to those from  other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. |
| 2.D.01.08 | WHST grades 9-10 #2a,b,d | 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. |
|  |  | Performance Example:  Through thorough reading of the text and other representations of the process through media sources or experimentation, students will compare and contrast plasma cutting and gas cutting by creating a list of advantages and disadvantages of each process and use the list to determine the best process to cut a given type of metal. |
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## [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.A.02.01-  03 | 5.MD.1  7.NS.3  G.MG.1 | Convert among different-sized standard measurement units within a given measurement system (e.g. convert 5 cm to 0.05 m) and use these conversions in solving multi-step, real-world problems.  Solve real-world and mathematical problems involving the four operations with rational number.  Use geometric shapes, their measures, and their properties to describe objects (e.g. modeling a tree trunk or a human torso as a  cylinder).  Performance Example:   * Given that a student’s hair becomes caught on a machine’s one inch diameter shaft which is rotating at 3,800 rpm’s and it takes three seconds of reaction time to turn the machine off. Determine the hair length a student must have to be able to turn off the machine before the hair is completely wrapped-up and ripped out of his/her head.   3,800 rpm x 3.14"= 11,932 inches of hair per minute  To convert from inches per min to inches per second multiple by 1 min/60 sec 11,932 in/min x 1min/60 sec = 198.9 in/sec  Convert inches per sec to feet per second by multiplying by 1ft/12in  198.9 in/sec x 1ft/12in = 16.6 ft./sec  In 3 seconds the length becomes 3sec x 16.6 ft/sec = 49.8ft!!! |
| 2.B.04.03 | 5.MD.1  7.NS.3 | Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.  Solve real-world and mathematical problems involving the four operations with rational number.  Performance Example:   * Students will refer to service / repair manual to determine the engine’s oil capacity. They will determine what grade & type is needed. (e.g. 15w40 ca for compression ignition, synthetic etc.). Given the price of oil per gallon students will calculate how much the cost will be to fill the system and if buying by the gallon how many gallons are needed.   Example:  27qts needed to fill system  1 Gallon = $9.16  Convert quarts to gallons:  27*qts*  1*gal*  6.75*gal*  4*qts*  6.75 gal x $9.16/gal = $61.83  The cost is $61.83 to buy 27 quarts. |
| 2.B.06.01-  06 | 7.NS.3 | Solve real-world and mathematical problems involving the four operations with rational number.  Performance Example:   * Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection.   Example:  10 gallon total capacity  10 X .60 = 6.0 gallons of antifreeze  10 gallon total – 6 gallons of antifreeze = 4 gallons of water |
| 2.B.10.01 | A-CED.4 | Rearrange formulas to highlight a quantity of interest, using the same  reasoning as in solving equations. For example, rearrange Ohm’s law V = IR to highlight resistance R.  Performance Example:   * Students will identify three types of circuits: series, parallel and series parallel. When given voltage, ohms, current or power (watts) students will use Ohm’s or Watts Law to find the unknown. Students will explain the proper safety precautions required for servicing, testing, and charging batteries.   Example:  I = E/R I = 12volts / 12 Ohms I = 1amp  R = E/I R = 12volts / 150 amps R = .08 ohms E = I X R E = 150 amps X .08 ohms E = 12volts  Using Ohm’s Law, V=IR, determine the resistance (R) of the starting motor circuit if the vehicle has a 12-volt battery and the starting motor draws 150 amperes of current.  Since our known values are voltage and current, we want to solve for resistance. Solve the formula V=IR for R  equation  The large battery cables and heavy starter windings provide little resistance to the current. (p. 526 Diesel Fundamentals Principles and Service Dales and Thiessen 1982) |
| 2.B.11.01 | G.MG.1  G-GMD.3 | Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).  Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.   * Performance Example: Using the service manual, students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs & Stratton OHV engine. Students will also explain the basic engine performance terms & formulas such as bore, stroke, compression ratio, horsepower & torque. When given a bore and stroke along with the number of cylinders students will calculate the engine’s displacement. * Calculating the displacement of an engine is exactly the same as finding the volume of a cylinder. You find the area of the circle inside the cylinder and multiply it by the height of the cylinder. (Remember that the area of a circle is pi times the radius squared.) * Volume = pi x radius squared x height * The volume of all the cylinders is equal, so to get total displacement, we multiply the volume of one cylinder by the number of cylinders. * When given a bore and stroke along with the number of cylinders students will calculate the engine’s displacement. * Example: Bore = 4.00” Stroke = 3.48” Cylinders = 8 * Diameter is the bore , so radius is half the bore or r = 2in Stroke is height so h = 3.48 in Use 3.14 for pi * Displacement is volume V = pi x r2 x h * = 3.14 x 22 x 3.48 * = 43.7088 cubic inches per cylinder * 8 cylinders 8 x 43.7088 = 349.67 cubic inches or about 350 cubic inches |
| 2.C.01.03-  2.C.01.04 | 7.NS.3 | Solve real-world and mathematical problems involving the four operations with rational number.  Performance Example:   * Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g., plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather materials and appropriate tools and construct the sawhorse according to the plans.   Example:  The Bill of Materials list includes;  4 pieces of lumber at ¾”x3¾”x24”  2 pieces of lumber at ¾”x3¾”x14¾” 2 pieces of lumber at ¾”x3¾”x9”  You have some leftover lumber - 1 piece at ¾”x3¾”x 10’ and 1 piece at ¾”x3¾”x15” Do you have enough on hand for this project?  To solve you need to determine the total length needed for ¾”x3¾” 4(24”) + 2(14¾”) + 2(9”) =  96” + 29 ½ “ + 18” =  143 ½ “ is total amount needed.  Currently on hand is 10’ or 120” and 15” for a total of 135”  You could use the 10’ board to cut the 4 – 24” pieces and the 2 – 9” pieces and the 15” piece for one of the 14¾” pieces. You need at least another 15” for this project. |
| 2.C.01.07 | 8.G.7 | Apply the Pythagorean Theorem to determine unknown side lengths  in right triangles in real-world and mathematical problems in two and three dimensions.  Performance Example:   * Students will be given a piece of plywood measuring 7’x9’. Using the Pythagorean Theorem, students will have to calculate the length of the diagonal for their piece of plywood. Students will then use this information to check if their piece of plywood is truly square.   a2 + b2 = c2 72 + 92 = c2  49 + 81 =130  c2 = 130  Square root of c2 = c  c= square root of 130 is about 11.4 feet  If the diagonal measures 11.4 ft or about 11 feet and 4 13/16 inches it is truly square. |
| 2.C.03.02 | G-CO.12 | Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given  line through a point not on the line.  Performance Example:   * When given a set of plans, students will be able to construct a basic structure (dog house, shed, etc.) and apply siding and roofing materials. Prior to construction, students will use the plans to calculate the total area of the walls and roof in order to estimate materials.   Example:   * After laying out the rectangular building to be sure the four corners are square, measure the distance diagonally from corner to corner. If all four corners are square, the diagonals will be equal in length. |
| 2C.03.06 | 8.G.7  7.G.6 | Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.  Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.  Performance Example:   * When given a set of plans, students will be able to construct a basic structure (dog house, shed, etc.) and apply siding and roofing materials. Prior to construction, students will use the plans to calculate the total area of the walls and roof in order to estimate materials.   Calculate the area of roof material in square feet, required for the structure shown in the above figure. Roofing material would be needed for the long rectangular sides. The formula for the area of a rectangle is length x width. We are given the length (16 ft) to find the width we will use Pythagorean Theorem.  a2 + b2 = c2 62 + 52 = c2  36 + 25 =61  c2 = 61  Square root of c2 = c  c= square root of 61 is about 7.8 feet  Area one side of roof = b x h = 16 x 7.8 = 124.8 sq ft Area of both sides of the roof 2 x 124.8 = 249.6 sq ft |
| 2.D.01.04-  2.D.01.06 | 7.NS.3 | Solve real-world and mathematical problems involving the four operations with rational number.  Performance Example:   * When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion due to heat.   Example: To safely use a welding machine, the operator must be aware of the duty cycle for the machine he/she is using. A welding machine with a 60% duty cycle can operate at rated amperage for minutes out of every 10 minutes without overheating.  Change 60% to the decimal .6, and then multiply by the time of 10 minutes.  .6 x 10 min = 6 minute. The welder can operate the machine for 6 minutes out of every 10 minutes. |
| 2.D.01.08 | 5.NF .2 | Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing  that 3/7 < 1/2.  Performance Example:   * When given a plan and the appropriate tools and materials, the student will properly cut pipe of mild steel. Example:   Your boss needs you to cut a length of pipe 3 ¾ ‘long from an eight foot length, how much will you have left? 8 – 3 ¾ = 4 ¼  You will have 4 ¼ feet of pipe left for your next project. |
| 2.E.02 | 7.NS.3 | Solve real-world and mathematical problems involving the four operations with rational number.  Performance Example:   * Students will be provided with a plan for a PVC pipe loop. From the plan students will determine the total quantity of pipe, the type and quantity of pipe fittings, necessary cleaners and primers, and appropriate tools. Students will then cut the PVC pipes to the correct lengths and assemble them according to the plans.   From the plan, it is determined a total of 144 feet of 2 inch PVC pipe will be needed. The pipe is sold in 20 foot lengths. What is the minimum number of 20 ft. lengths that must be purchased?  144 ft./20ft. = 7.2 since you cannot buy partial lengths, round up to 8. You would need to purchase 8 20 ft. lengths of PVC pipe. |
| 2.C.03.08 | G-GMD.3  5.MD.1 | Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.  Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.  Performance Example:   * Students will be given a plan for a concrete block that they are to produce. From these plans, students will have to figure out the size of the form that they need to build in order to produce the correct size concrete block. Once students have figured out the size that their form needs to be, they will create a working drawing of their form. Once a working drawing of their form is created they will calculate the quantity and cost of the materials needed to construct their form. Students will then gather their materials, construct their forms, and check their forms for square. Once the form is constructed, the students will estimate concrete needs by using formulas for volume and converting answers into cubic yards. Following the manufacturer’s instructions, students will then mix concrete, pour it into their form and follow appropriate finishing methods. * Student will construct a concrete form. The student will then mix concrete, pour it into their form, and finish the concrete.   Example:  You need to order concrete for completing eighty footers. You must determine the quantity and cost for the order. The footers will have a diameter of 12 inches and a depth of 36 inches. You must calculate the volume for one footer and the multiply by 8. When ordering, add an extra 10% to your total.  Volume formula for a cylinder Volume = pi times radius squared times height V = 3.14 x 6 x6 x 36 (radius is half the diameter)  V = 4096.44 inches cubed  Volume for 80 footings 80(4096.44) = 327715.2 inches cubed  10% of volume .1(327715.2)= 32771.52 inches cubed 327715.2 in cubed + 32771.52 in cubed = 360486.72 in cubed To order convert to yards cubed.  360486.72 in cubed x 1ft cubed x 1yd cubed  1728 in cubed 27 ft cubed  = 7.73 cubic yards  You must order to the closest half yard so round up to 8 cubic yards. Concrete costs $125/cubic yard delivered.  8 cubic yards x $125/cubic yard = $1000. |

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

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

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Biology Learning Standard |
| 2A.01.02  2A.01.03  2A.01.04 | 1. The Chemistry of Life 1.1 | Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, and S. |
|  | 1. The Chemistry of Life 1.2 | Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, nucleic acids). |
|  | 1. The Chemistry of Life 1.3 | Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature that have an effect on enzymes.  Performance Example:   * As part of the preparation to work within the agricultural industry, students will research and develop presentations to share with the class on biological hazards and appropriate safety measures to protect workers in the field. Students will include a basic introduction of biological organism composition, how these are structured and how temperature (climate), environmental conditions (pH, water/soil) impact living   organisms. These presentations will provide a context for understanding the fundamental biological concepts related to the agricultural industry. Presentations will include multimedia tools. |
| 2.B.08 | SIS1. Make observations, raise questions, and formulate hypotheses. | Observe the world from a scientific perspective.  Pose questions and form hypotheses based on personal observations, scientific articles, experiments, and knowledge.  Read, interpret, and examine the credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories.  Performance Example:   * In preparation for the service of hydraulic systems, students will engage in a series of experiments   dramatizing the functions of the system as a whole. This preparation will include the reading and summarizing of trade articles on hydraulic system components. |
| 2.B.06 | SIS2. Design and conduct scientific investigations. | Articulate and explain the major concepts being investigated and the purpose of an investigation.  Select required materials, equipment, and conditions for conducting an experiment.  Identify independent and dependent variables. Write procedures that are clear and replicable.  Employ appropriate methods for accurately and consistently   * making observations * making and recording measurements at appropriate levels of precision * collecting data or evidence in an organized way Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, and computers) including   set-up, calibration (if required), technique, maintenance, and  storage.  Follow safety guidelines.  Performance Example:   * After unit lessons on each of the welding techniques and practice sessions to gain both confidence and form, students will repair or assemble a piece of agricultural equipment out of metal. Students may select to create a blade for a trowel or hoe, or repair a loose piece. Once the pieces are completed, members of the advisory board will come in to evaluate the repair/design of the finished metal work. The work will be evaluated on quality of work and effective use of the different welding techniques. Students will include a one page written document on the process they used and why they used the techniques they did, including safety considerations for both the process and the final product. * The student will demonstrate a step-by-step procedure for the recommended method of checking for leaks in gas welding equipment. * When given a project plan with dimensions/angles and the appropriate equipment and materials needed, the student will follow a listed procedure and weld together the project utilizing tack welds to control distortion   due to heat. |

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

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Chemistry Learning Standard |
| 2.A.01 | 5. Chemical Reactions and Stoichiometry 5.2 | Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.  Performance Example:   * Students will describe proper safety procedures for working around battery electrolyte (mixture of sulfuric acid and water w/production of hydrogen gas) and make a list of possible ignition sources. |
| 2.B02 | 6. States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.1 | Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle’s law), volume and temperature (Charles’s law), pressure and temperature (Gay- Lussac’s law), and the number of particles in a gas sample (Avogadro’s hypothesis). Use the combined gas law to determine  changes in pressure, volume, and temperature.  Performance Example:   * Students will refer to the tire manufacturer/operator’s manual and set tire pressure to specifications and also explain what effect ambient and tire temperature have on tire pressure. |
| 2.B.05 | 6. States of Matter, Kinetic Molecular Theory, and Thermochemistry 6.1 | Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle’s law), volume and temperature (Charles’s law), pressure and temperature (Gay- Lussac’s law), and the number of particles in a gas sample (Avogadro’s hypothesis). Use the combined gas law to determine  changes in pressure, volume, and temperature.  Performance Example:   * When given breakdown, students will identify the parts of a turbocharger and also explain how it operates and what happens to the combustion air while going thru the turbocharger and the advantages of cooling it   before it reaches the combustion chamber. |
| 2.B.06 | 7. Solutions, Rates of Reaction, and Equilibrium | Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).  Performance Example:   * Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity, students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection.   Example:  10 gallon total capacity  10 X .60 = 6.0 gallons of antifreeze  10 gallon total – 6 gallons of antifreeze = 4 gallons of water |
| 2.D.01 | 3. Periodicity 3.3 | Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.  Performance Example:   * The student will name eight gases which are commonly used in the welding industry and classify them as either a fuel gas or a shielding gas. (acetylene, argon, propane, nitrogen, helium, CO2, natural gas,   propylene, etc. ) |

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

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Physics Learning Standard |
| 2.A.02 | 1. Motion and Forces 1.8 | Describe conceptually the forces involved in circular motion.  Performance Example:   * Given that a student’s hair becomes caught on a machine’s one inch diameter shaft which is rotating at 3,800 rpm’s and it takes three seconds of reaction time to turn the machine off. Determine the hair length a student must have to be able to turn off the machine before the hair is completely wrapped-up and ripped   out of his/her head. |
| 2.B.10 | 5. Electromagnetism 5.2 | Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm’s law). |
| 2.B.10 | 5. Electromagnetism 5.3 | Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the  functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram. |

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#### [Technology/Engineering](#_bookmark0)

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Technology/Engineering Learning Standard |
| 2.A.02.02 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * Given a power tool and the manufacturer’s operator’s manual as a reference, the student will determine and verify by making a check list, if all guards and other safety devices are in place and in proper working   condition. |
| 2.A.02 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * Determine the needed hair length for a student to be able to safely turn off equipment after his/her hair has become caught on a rotating part. (1” shaft rotating at 3800 rpm’s w/student reaction time of 3 sec.) * Students will refer to service manual for proper clutch adjustment procedure, and explain in an oral presentation why it is important to maintain proper adjustment and what the function of the clutch is in the   driveline. |
| 2.B.06 | 4. Energy and Power Technologies—Thermal  Systems 4.1 | Differentiate among conduction, convection, and radiation in a thermal system (e.g. heating and cooling a house, cooking). |
|  |  | Performance Example:   * Students will explain how a liquid cooling system operates, list the major components, and also explain how the liquid in the system can function in both extreme cold without freezing and extreme heat without boiling. Given a cooling system total capacity, students will figure the amount of antifreeze needed for a 60% mixture of antifreeze and 40% water for proper freeze protection.   Example:  10 gallon total capacity 10 X .60 =6.0 gallons  10 gallon total – 6 gallons of antifreeze = 4 gallons of water |
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| 2.B.11 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * Using the service manual and appropriate tools, students will follow the proper procedures to disassemble and assemble a 6.5hp Briggs and Stratton OHV engine. Students will also explain the basic engine performance terms and formulas such as bore, stroke, compression ratio, horsepower and torque. When given a bore and stroke along with the number of cylinders students will calculate the engine’s displacement.   Example:  Bore = 4.00”  Stroke = 3.48”  Cylinders = 8  Displacement = R2 x 3.14 x stroke x cylinders R2 = 4.00  Stroke = 3.48  Pi = 3.14  4.00 x 3.14 = 12.56 x 3.48 = 43.7088 Cubic Inch x 8 = 349.67 or 350 Cubic Inch |
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| 2.C.02 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g., plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather the materials and tools they need, and construct the sawhorse according to the plans. |
| 2.C.01 | 1. Engineering Design 1.5 | Interpret plans, diagrams, and working drawings in the construction of prototypes or models.  Performance Example:   * Students will be given a plan for a concrete block that they are to produce. From these plans, students will have to figure out the size of the form that they need to build in order to produce the correct size concrete block. Once students have figured out the size that their form needs to be, they will create a working drawing of their form. Once a working drawing of their form is created they will calculate the quantity and cost of the materials needed to construct their form. Students will then gather their materials, construct their forms, and check their forms for square. Once the form is constructed, the students will estimate concrete needs by using formulas for volume and converting answers into cubic yards. Following the manufacturer’s instructions, students will then mix concrete, pour it into their form and follow appropriate   finishing methods. |
| 2.C.02 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * Students will be given a set of plans for a sawhorse. From the plans, the students will first have to select the appropriate materials for each part of the sawhorse and explain why each particular material was chosen (e.g. plywood gussets for tensile strength). The students will then estimate quantity and cost of the materials for the sawhorse project. Using their materials lists, students will then gather materials, and tools they need and construct the sawhorse according to the plans. |
| 2.D.02.07-  2.D.02.09 | 2. Construction Technologies  2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:   * When given the appropriate tools and materials, the student will safely and properly drill and tap a hole to a 60%, 3/8-16 thread in the center of a 2 ½” x 1 ½” x ¼” thick piece of mild steel. |
| 2.E.01 | 3. Energy and Power Technologies—Fluid Systems  3.1 | Explain the basic differences between open fluid systems (e.g. irrigation, forced hot air system, air compressors) and closed fluid  systems (e.g., forced hot water system, hydraulic brakes).  Performance Example:   * Students will choose a land area (yard, athletic field, golf course, etc.) and perform an analysis on that land area where they discuss the pros and cons of three different kinds of irrigation systems. |

# [Industry Recognized Credentials](#_bookmark0) (Licenses and Certifications/Specialty Programs)

10-Hour OSHA General Industry Card/Credential\* [OSHA General Industry Training Guidelines](http://www.osha.gov/dte/outreach/generalindustry/index.html)

10-hour Construction Industry Card/Credential\* [OSHA Construction Industry Training Guidelines](http://www.osha.gov/dte/outreach/construction/index.html)

CPR & First Aid Training Card/Credential\*

American Heart Association and American Red Cross Massachusetts Hoisting License

[Massachusetts Executive Office of Public Safety and Security](http://www.mass.gov/eopss/consumer-prot-and-bus-lic/license-type/hoisting/)

Massachusetts Commercial Driver’s License [Massachusetts Department of Motor Vehicles](http://www.mass.gov/rmv/license/8cdl.htm)

Outdoor Power Equipment Technician Certifications\*

Two Stroke Engines, Four Stroke Engines, Compact Diesel Engines, Equipment Electrical Systems Equipment Engine Training Council (EETC)

Certified Welder

American Welding Society (AWS)

Certified Welding Fabricator American Welding Society (AWS)

National Institute for Automotive Service Excellence (ASE) ASE Certifications

\*Can be earned by student prior to graduation.