

Vermont Career Technical Education (CTE) Program Critical Proficiencies

Electrical, HVAC, Plumbing CTE Programs

The Critical Proficiencies identify the essential knowledge, skills, and abilities that VT CTE students need to demonstrate (1) to be program completers, and (2) to be prepared for future learning. Critical proficiencies promote high expectations for all students, and support students' personal, professional, and academic development. At the high school level, VT's Proficiency-Based Graduation Requirements (PBGRs) reflect the critical proficiencies that lead to postsecondary career and college readiness.

For each of the unique program areas which categorize VT's CTE programs, the proficiency template includes:

- Program-Area Descriptions
- Career Ready Practices
- Career Cluster(s) and Pathway(s)
- Anchor Standards
- Program Technical Standards
- Academic Alignment
- CTE Program Elements

Advance CTE Common Career Technical Core - Career Ready Practices

The Common Career Technical Core (CCTC) is a state-led initiative to establish a set of rigorous, high-quality standards for Career Technical Education (CTE). The CCTC includes a set of standards for each Career Cluster® and corresponding Career Pathways that define what students should know and be able to do after completing instruction in a program of study. The CCTC also includes an overarching set of Career Ready Practices that apply to all programs of study. The Career Ready Practices include statements that address the knowledge, skills, and dispositions that are important to becoming career ready.

The Career Ready Practices were developed from a state-led initiative sponsored by the National Association of State Directors of Career Technical Education Consortium (NASDCTEC).

Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline, or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study. (NASDCTEC, 2012)

The Career Ready Practices

- are applicable across all program areas.
- align with the VT Transferable Skills Proficiency-Based Graduation Requirements (PBGRs) and VT Portrait of a Graduate.
- are the *transferable skills* of the Common Career Technical Core and the *portrait* of a VT CTE program completer.

Advance CTE Common Career Technical Core - Career Cluster and Pathway Standards

The Common Career Technical Core is divided into Career Cluster and Pathway standards. Each Career Cluster contains one or more pathways with pathway-specific technical standards. The template shows which CCTC Career Cluster and Pathway standards are relevant to VT CTE programs.

Anchor Standards

The Anchor Standards build upon the Career Ready Practices and show the overarching standards categories which are common across all technical programs within their Career Cluster(s) and Pathway(s). The VT CTE Anchor Standards are derived from and align with the CCTC Anchor Standards.

Program Technical Standards

The Program Technical Standards build on and continue the Anchor Standards with more complexity, rigor, and career specificity. Knowledge and skills are learned and applied within a standards-based CTE program that integrates classroom, laboratory, and work-based instruction. The VT CTE Program Technical Standards are tailored to the unique characteristics and structure of each of the program areas.

Academic Alignment

Each program-area template includes academic alignment with the VT Content-Area Sample Graduation Proficiencies as part of VT's Proficiency-Based Graduation Requirements (PBGRs). These include Common Core State Standards in English Language Arts and Mathematics, Next Generation Science Standards, as well as other adopted national and state academic standards.

CTE Critical Proficiency Template

Critical Proficiency Template:	Attributes:
Program-Area Descriptions	For VT CTE Program Areas
Common Career Technical Core - Career Ready Practices	<ol style="list-style-type: none"> 1. Act as a responsible and contributing citizen and employee. 2. Apply appropriate academic and technical skills. 3. Attend to personal health and financial well-being. 4. Communicate clearly and effectively and with reason. 5. Consider the environmental, social, and economic impacts of decisions. 6. Demonstrate creativity and innovation. 7. Employ valid and reliable research strategies. 8. Utilize critical thinking to make sense of problems and persevere in solving them. 9. Model integrity, ethical leadership, and effective management. 10. Plan education and career paths aligned to personal goals. 11. Use technology to enhance productivity. 12. Work productively in teams while using cultural global competence.
Common Career Technical Core - Career Cluster(s) and Pathway(s)	Relevant to VT CTE Program Areas
Anchor Standards	<ol style="list-style-type: none"> 1. Academics 2. Communication 3. Problem Solving and Critical Thinking 4. Technology 5. Systems (Responsibility and Flexibility) 6. Health and Safety 7. Leadership and Teamwork 8. Ethics and Legal Responsibilities 9. Career Planning and Management 10. Technical Knowledge and Skills (see Program Technical Standards) 11. Demonstration and Application (see CTE Program Elements)

Critical Proficiency Template:	Attributes:
Program Technical Standards	Build on the Anchor Standards with more complexity, rigor, and career specificity
Academic Alignment	With VT Content-Area Graduation Proficiencies
CTE Program Elements	Demonstration and application: <ul style="list-style-type: none"> ● Dual Enrollment/Fast Forward Courses ● Industry Recognized Credentials (IRCs) ● Work-Based Learning/Co-op/Apprenticeship ● National Career Technical Student Organizations ● Entrepreneurship ● Portfolio/Personalized Learning Plan

VT Electrical, HVAC, Plumbing CTE Programs

Students in **Electrical** programs have in-depth, hands-on experiences in electrical systems and structures; safety, tools, and equipment; electrical code and theory; wiring and electrical components; circuit breaker panels, switches, and light fixtures; blueprints; state and local codes.

Students in **HVAC** programs have in-depth, hands-on experiences in HVAC systems and structures; thermodynamics; components of the refrigeration cycle; compressors and refrigerants; basic electricity; introduction to heating and combustion; metering devices; piping principles; soldering and brazing.

Students in **Plumbing** programs have in-depth, hands-on experiences in installing, maintaining, and repairing different types of pipe systems; plumbing theory and code; drain, waste, and vent systems; water supply distribution systems; pipes, valves, fittings, and fixtures; energy efficiency and conservation.

The standards in this program area are designed to prepare students for technical training, postsecondary education, and/or entry-level employment in the electrical, HVAC, and plumbing industries. Students engage in an instructional program that integrates academic and technical preparation, career exploration, and preparation for postsecondary education and/or training. Knowledge and skills are learned and applied within a standards-based CTE program that integrates classroom, laboratory, and work-based instruction.

Advance CTE Common Career Technical Core - Career Ready Practices

<p>Advance CTE Common Career Technical Core - Career Ready Practices:</p>	<p>Aligned with VT Transferable Skills Proficiency-Based Graduation Requirements (PBGRs) and VT Portrait of a Graduate</p>
<p>1. Act as a responsible and contributing citizen and employee.</p>	<p>Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community, and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.</p>
<p>2. Apply appropriate academic and technical skills.</p>	<p>Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.</p>
<p>3. Attend to personal health and financial well-being.</p>	<p>Career-ready individuals understand the relationship between personal health, workplace performance, and personal well-being; they act on that understanding to regularly practice healthy diet, exercise, and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial wellbeing, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.</p>

<p>Advance CTE Common Career Technical Core - Career Ready Practices:</p>	<p>Aligned with VT Transferable Skills Proficiency-Based Graduation Requirements (PBGRs) and VT Portrait of a Graduate</p>
<p>4. Communicate clearly and effectively and with reason.</p>	<p>Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.</p>
<p>5. Consider the environmental, social, and economic impacts of decisions.</p>	<p>Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment, and the profitability of the organization.</p>
<p>6. Demonstrate creativity and innovation.</p>	<p>Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.</p>
<p>7. Employ valid and reliable research strategies.</p>	<p>Career-ready individuals are discerning in accepting and using new information to make decisions, change practices, or inform strategies. They use reliable research processes to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.</p>

<p>Advance CTE Common Career Technical Core - Career Ready Practices:</p>	<p>Aligned with VT Transferable Skills Proficiency-Based Graduation Requirements (PBGRs) and VT Portrait of a Graduate</p>
<p>8. Utilize critical thinking to make sense of problems and persevere in solving them.</p>	<p>Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.</p>
<p>9. Model integrity, ethical leadership, and effective management.</p>	<p>Career-ready individuals consistently act in ways that align personal and community-held ideals and principles while employing strategies to positively influence others in the workplace. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the directions and actions of a team or organization, and they apply insights into human behavior to change others' actions, attitudes, and/or beliefs. They recognize the near-term and long-term effects that management's actions and attitudes can have on productivity, morals, and organizational culture.</p>
<p>10. Plan education and career paths aligned to personal goals.</p>	<p>Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience, and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.</p>

Advance CTE Common Career Technical Core - Career Ready Practices:	Aligned with VT Transferable Skills Proficiency-Based Graduation Requirements (PBGRs) and VT Portrait of a Graduate
11. Use technology to enhance productivity.	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks - personal and organizational - of technology applications, and they take actions to prevent or mitigate these risks.
12. Work productively in teams while using cultural global competence.	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural differences to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

Advance CTE Common Career Technical Core [Architecture and Construction](#) Career Cluster and Pathway Standards

The following Career Cluster and Pathway standards are relevant to VT Electrical, HVAC, Plumbing CTE programs:	This Career Cluster® is focused on careers in designing, planning, managing, building and maintaining the built environment.
Architecture and Construction Career Cluster	<ol style="list-style-type: none"> 1. Use vocabulary, symbols, and formulas common to architecture and construction. 2. Use architecture and construction skills to create and manage a project. 3. Comply with regulations and applicable codes to establish and manage a legal and safe workplace. 4. Evaluate the nature and scope of the Architecture & Construction Career Cluster and the role of architecture and construction in society and the economy. 5. Describe the roles, responsibilities, and relationships found in the architecture and construction trades and professions, including labor/management relationships. 6. Read, interpret, and use technical drawings, documents and specifications to plan a project. 7. Describe career opportunities and means to achieve those opportunities in each of the Architecture & Construction Career Pathways.

<p>The following Career Cluster and Pathway standards are relevant to VT Electrical, HVAC, Plumbing CTE programs:</p>	<p>This Career Cluster® is focused on careers in designing, planning, managing, building and maintaining the built environment.</p>
<p>Construction Pathway</p>	<ol style="list-style-type: none"> 1. Describe contractual relationships between all parties involved in the building process. 2. Describe the approval procedures required for successful completion of a construction project. 3. Implement testing and inspection procedures to ensure successful completion of a construction project. 4. Apply scheduling practices to ensure the successful completion of a construction project. 5. Apply practices and procedures required to maintain jobsite safety. 6. Manage relationships with internal and external parties to successfully complete construction projects. 7. Compare and contrast the building systems and components required for a construction project. 8. Demonstrate the construction crafts required for each phase of a construction project. 9. Safely use and maintain appropriate tools, machinery, equipment and resources to accomplish construction project goals.
<p>Maintenance/Operations Pathway</p>	<ol style="list-style-type: none"> 1. Recognize and employ universal construction signs and symbols to function safely in the workplace. 2. Use troubleshooting procedures when solving a maintenance problem in buildings. 3. Apply construction skills when repairing, restoring, or renovating existing buildings. 4. Determine work required to repair or renovate an existing building. 5. Plan and practice preventative maintenance activities to service existing buildings. 6. Maintain and inspect building systems to achieve safe and efficient operation of buildings.

VT CTE Program Anchor Standards

<p>Anchor Standards:</p>	<p>Aligned with Advance CTE Common Career Technical Core - Career Cluster Anchor Standards</p>
<p>1. Academics</p>	<p>Achieve additional academic knowledge and skills required to pursue the full-range of career and postsecondary education opportunities.</p>

Anchor Standards:	Aligned with Advance CTE Common Career Technical Core - Career Cluster Anchor Standards
2. Communication	Acquire and accurately use terminology and information at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.
3. Problem Solving and Critical Thinking	Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem using critical and creative thinking; logical reasoning, analysis, inquiry, and problem-solving techniques.
4. Technology	Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the workplace environment.
5. Systems (Responsibility and Flexibility)	Initiate, and participate in, a range of collaborations to demonstrate behaviors that reflect personal and professional responsibility, flexibility, and respect in the workplace environment and community settings.
6. Health and Safety	Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the workplace environment.
7. Leadership and Teamwork	Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution.
8. Ethics and Legal Responsibilities	Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.
9. Career Planning and Management	Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.
10. Technical Knowledge and Skills (see Program Technical Standards)	Apply essential technical knowledge and skills common to the Career Cluster and Pathway(s), following procedures when carrying out experiments and/or performing technical tasks.

Anchor Standards:	Aligned with Advance CTE Common Career Technical Core - Career Cluster Anchor Standards
11. Demonstration and Application (see CTE Program Elements)	Demonstrate and apply technical knowledge and skills across a variety of CTE-specific opportunities in classroom, laboratory, and workplace settings.

VT Electrical CTE Program Technical Standards

Program Technical Standards: Aligned with NCCER Electrical Level 1 & 2	Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.
1. Workplace Hazards and Personal Safety	<ul style="list-style-type: none"> a. Identify electrical hazards and electrical safety issues and how to avoid or minimize them in the workplace. b. Develop a task plan and hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task.
2. Electrical Theory and Electrical Circuits	<ul style="list-style-type: none"> a. Define voltage, current, resistance, and power and describe how they are related. b. Use Ohm's law to calculate the current, voltage, and resistance in a circuit. c. Use the power formula to calculate how much power is consumed by a circuit. d. Describe the differences between series and parallel circuits and calculate circuit loads for each type. e. Describe how voltage, current, and resistance are measured.
3. Electrical Code Requirements	<ul style="list-style-type: none"> a. Explain the role of the National Electrical Code® in residential wiring and describe how to determine electric service requirements.
4. Electrical Installation Requirements	<ul style="list-style-type: none"> a. Explain the grounding requirements of a residential electric service. b. Calculate and select service-entrance equipment (i.e., panel box, load requirements, breakers). c. Select the proper wiring methods for various types of residential construction systems. d. Describe the installation rules for dedicated circuits for various equipment (e.g., ranges, dryers, HVAC systems, hot tubs, water heaters, etc.).

<p>Program Technical Standards:</p> <p>Aligned with NCCER Electrical Level 1 & 2</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
	<ul style="list-style-type: none"> e. Explain how wiring devices are selected and installed. f. Identify and describe various load and control devices and explain how they are represented on circuit diagrams.
<p>5. Materials and Methods of Electrical Installation</p>	<ul style="list-style-type: none"> a. Read, interpret, and apply information on electrical construction drawings. b. Identify and utilize appropriate electrical tools and equipment. c. Select and use hand bending equipment. d. Compute branch circuit loads and explain their installation requirements. e. Discuss the types and purposes of equipment grounding conductors. f. Explain the purpose and appropriate usage of ground fault circuit interrupters. g. Explain the purpose and appropriate usage of arc fault circuit interrupters. h. Size outlet boxes and select the proper type for different wiring methods. i. Describe the installation and control of lighting fixtures. j. Install a basic electrical system.
<p>6. Communication</p>	<ul style="list-style-type: none"> a. Demonstrate effective verbal and written communication skills in the electrical classroom, lab, and work site.
<p>7. Leadership and Teamwork</p>	<ul style="list-style-type: none"> a. Demonstrate an ability to work independently and as a collaborative team member in the electrical industry.
<p>8. Ethics and Legal Responsibilities</p>	<ul style="list-style-type: none"> a. Explain the professional and ethical standards that are required in the electrical industry.
<p>9. Career Development</p>	<ul style="list-style-type: none"> a. Identify the various career and trade options, including apprenticeship, and understand the training and certification process for electricians.

VT HVAC CTE Program Technical Standards

<p>Program Technical Standards:</p> <p>Aligned with NCCER HVAC Level 1 & 2</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>1. Safety, Health, and Environmental</p>	<ul style="list-style-type: none"> a. Identify HVAC hazards and safety issues and how to avoid or minimize them in the workplace. b. Develop a task plan and hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task. c. Describe what the Clean Air Act means to the HVAC trade.
<p>2. HVAC Theory</p>	<ul style="list-style-type: none"> a. Explain the basic principles of heating, ventilation, air conditioning, and refrigeration. b. Describe the principles that guide HVAC installation and service techniques. c. Apply mathematical concepts to HVAC applications. d. Read, interpret, and apply information on HVAC and construction drawings.
<p>3. HVAC Code Requirements</p>	<ul style="list-style-type: none"> a. Identify HVAC code regulations and requirements.
<p>4. HVAC Methods, Tools, and Equipment</p>	<ul style="list-style-type: none"> a. Identify and utilize hand tools, power tools, and equipment. b. Utilize appropriate material handling techniques.
<p>5. Introduction to Electricity</p>	<ul style="list-style-type: none"> a. Describe the fundamentals of electricity. b. Explain basic electrical theory. c. Describe how electrical measuring instruments are used in HVAC work. d. Identify electrical components used in HVAC systems and describe their functions.
<p>6. Thermodynamics and Heat Transfer</p>	<ul style="list-style-type: none"> a. Describe the science of refrigeration and heating. b. Explain the science of fluids and pressures as they relate to air conditioning and refrigeration. c. Explain the relationship of the components of the refrigeration cycle.
<p>7. Heating and Combustion</p>	<ul style="list-style-type: none"> a. Explain fundamental concepts of heating and combustion. b. Describe various heating systems.

<p>Program Technical Standards:</p> <p>Aligned with NCCER HVAC Level 1 & 2</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>8. Refrigeration Systems</p>	<ul style="list-style-type: none"> a. Explain fundamental concepts of the refrigeration cycle. b. Describe the relationship of the components of the refrigeration cycle. c. Identify major components of cooling systems and how they function. d. Identify the common controls used in cooling systems.
<p>9. Piping Principles</p>	<ul style="list-style-type: none"> a. Recognize and identify different types of copper tubing and their related fittings. b. Describe and demonstrate how to join copper tubing mechanically. c. Recognize different types of plastic piping and show how it can be joined. d. Describe and demonstrate the safe process of soldering copper tubing. e. Describe and demonstrate the safe process of brazing copper tubing. f. Describe and identify the various types of steel pipe and fitting. g. Describe the tools and methods used to cut and thread steel pipe. h. Explain and demonstrate the methods of installing and mechanically joining steel pipe.
<p>10. Compressors</p>	<ul style="list-style-type: none"> a. Describe the common causes of compressor failures. b. Identify and explain the operation of various compressor protection devices. c. Explain how to analyze the operation of a hermetic compressor.
<p>11. Aspects of Refrigerants</p>	<ul style="list-style-type: none"> a. Describe the desirable characteristics of refrigerants and the various applications that require them. b. Identify refrigerant classifications and describe their environmental impact. c. Explain how to use pressure-temperature (PT) charts to calculate superheat and subcooling. d. Identify and describe lubricating oils and issues related to their function. e. Describe the equipment and approaches used to

<p>Program Technical Standards:</p> <p>Aligned with NCCER HVAC Level 1 & 2</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
	<p>leak test refrigerant circuits.</p> <p>f. Describe refrigerant containment and management requirements and the equipment used to recover refrigerants.</p> <p>g. Explain the related principles and identify the equipment used to evacuate refrigerant circuits.</p> <p>h. Describe the procedures for charging refrigerant circuits.</p>
<p>12. Metering Devices</p>	<p>a. Explain the function of refrigerant metering devices and their effect on refrigerants.</p> <p>b. Identify fixed metering devices and explain how they function.</p> <p>c. Identify types of expansion valves and explain how they operate.</p>
<p>13. Communication</p>	<p>a. Demonstrate effective verbal and written communication skills in the HVAC classroom, laboratory, and work site.</p>
<p>14. Leadership and Teamwork</p>	<p>a. Demonstrate an ability to work independently and as a collaborative team member in the HVAC industry.</p>
<p>15. Ethics and Legal Responsibilities</p>	<p>a. Recognize the professional and ethical standards that are required in the HVAC industry.</p>
<p>16. Career Development</p>	<p>a. Explore the various sectors and trade options in the HVAC industry and understand the training and certification process for technicians; identify the various career paths available to HVAC technicians (including journey person, foreperson, superintendent, project manager, estimator, engineer, etc.).</p> <p>b. Recognize the financial, managerial and legal factors important in operating a sole proprietor, subchapter S, or LLC HVAC business.</p>

VT Plumbing CTE Program Technical Standards

<p>Program Technical Standards:</p> <p>Aligned with NCCER Plumbing Level 1</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>1. Safety, Health, and Environmental</p>	<ul style="list-style-type: none"> a. Identify plumbing hazards and safety issues and how to avoid or minimize them in the workplace. b. Develop a task plan and hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task.
<p>2. Plumbing Theory</p>	<ul style="list-style-type: none"> a. Define the purpose and basic installation components of plumbing systems. b. Use mathematical calculations to size and install plumbing systems. c. Read, interpret, and apply information on plumbing and construction drawings.
<p>3. Plumbing Code Requirements</p>	<ul style="list-style-type: none"> a. Summarize plumbing code regulations and requirements. b. Identify code violations and related consequences.
<p>4. Plumbing Methods, Tools, and Equipment</p>	<ul style="list-style-type: none"> a. Identify and utilize appropriate plumbing tools and equipment. b. Demonstrate soldering and brazing techniques for copper tubing and fittings. c. Demonstrate cutting and joining techniques for copper, iron, and plastic pipe.
<p>5. Drain, Waste, and Vent (DWV) Systems</p>	<ul style="list-style-type: none"> a. Explain how waste moves from a fixture through the drain system to the environment. b. Identify the major components of a drainage system and describe their functions. c. Investigate the different types of traps, usages, and applications; calculate pipe sizes based on drainage fixture units (DFUs). d. Describe the various types of drain, waste, and vent (DWV) fittings and their applications.

<p>Program Technical Standards:</p> <p>Aligned with NCCER Plumbing Level 1</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>6. Water Supply and Distribution Systems: Interior</p>	<ul style="list-style-type: none"> a. Explain how water is moved from source to point of use. b. Identify the different sources of domestic potable water. c. Identify the sources and uses of non-potable water. d. Identify the parts of interior water distribution systems. e. Calculate pipe sizes based on water supply fixture units. f. Discuss the relationships between pressure, volume, and flow rates, and explain pipe sizing methods and considerations.
<p>7. Water Supply and Distribution Systems: Exterior and Below Ground</p>	<ul style="list-style-type: none"> a. Explain how water is moved from source to point of use. b. Identify the different sources of domestic potable water. c. Identify the sources and uses of non-potable water. d. Calculate pipe sizes based on water supply fixture units. e. Identify the parts of below ground water distribution systems. f. Discuss the relationships between pressure, volume, and flow rates, and explain pipe sizing methods and considerations.
<p>8. Valves, Fittings and Pumps</p>	<ul style="list-style-type: none"> a. Identify common types of valves and fittings and their general applications. b. Identify common types of pumps and their applications.

<p>Program Technical Standards:</p> <p>Aligned with NCCER Plumbing Level 1</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>9. Plastic Pipe and Fittings (PVC, ABS, CPVC)</p>	<ol style="list-style-type: none"> a. Identify and safely operate the tools and equipment for plastic pipe and fittings. b. Identify types of materials and schedules of plastic piping. c. Recognize proper and improper applications of plastic piping. d. Identify types of fittings and valves used with plastic piping. e. Determine the kinds of hangers and supports needed for plastic piping. f. Demonstrate the various techniques used in hanging and supporting plastic piping. g. Explain proper procedures for the handling, storage, and protection of plastic pipes. h. Calculate angles and slope, measure, cut, and join plastic piping (e.g., connectors, glues, solvents). i. Install a basic plastic piping system. j. Demonstrate the proper cleanup procedures for specific joining materials. k. Identify and demonstrate the methods for testing plastic piping.

<p>Program Technical Standards:</p> <p>Aligned with NCCER Plumbing Level 1</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>10. Copper Pipe and Fittings; PEX Pipe and Fittings; Cast Iron Pipe and Fittings</p>	<ul style="list-style-type: none"> a. Identify and safely operate the tools and equipment for copper, PEX, and cast iron pipe and fittings. b. Identify the types of materials and schedules used with copper, PEX, and cast iron piping. c. Identify the material properties, storage, and handling requirements of copper, PEX, and cast iron piping. d. Identify the types of fittings and valves used with copper, PEX, and cast iron piping. e. Demonstrate the techniques used in hanging and supporting copper, PEX, and cast iron piping. f. Calculate angles, measure, cut, and join copper, PEX, and cast iron piping. g. Install a basic copper, PEX, and cast iron piping system. h. Identify the specific hazards and safety precautions associated with copper, PEX, and cast iron piping. i. Identify and demonstrate the methods for testing copper, PEX, and cast iron piping.
<p>11. Basic Carbon Steel Piping Practices</p>	<ul style="list-style-type: none"> a. Identify the characteristics and uses of steel pipe. b. Describe how pipe threads are classified and measured. c. Identify the various types of fittings used on steel pipe and describe how they are used. d. Describe how to properly measure lengths of steel pipe. e. Identify pipe cutting and reaming tools and describe how they are used. f. Identify threading tools and describe how they are used. g. Explain and demonstrate the methods and use of the tools to connect threaded pipe. h. Explain and demonstrate an understanding of pipe grooving methods. i. Describe how to assemble flanged steel pipe. j. Describe how to correctly install steel pipe.

<p>Program Technical Standards:</p> <p>Aligned with NCCER Plumbing Level 1</p>	<p>Standards for each career path build on and continue the Anchor Standards with more complexity, rigor, and career specificity.</p>
<p>12. Plumbing Fixtures</p>	<ul style="list-style-type: none"> a. Identify common plumbing fixtures and their applications including faucets, valves, supports, drainage fittings, and controls. b. Describe and demonstrate the proper installation of common plumbing fixtures and their appurtenances.
<p>13. Hot Water Heaters</p>	<ul style="list-style-type: none"> a. Identify common types of water heaters and their applications. b. Describe and demonstrate the proper installation of water heaters and their common appurtenances including the application and theory pertaining to thermostatic mixing valves.
<p>14. Energy Efficiency and Water Conservation in the Plumbing Industry</p>	<ul style="list-style-type: none"> a. Identify low flow plumbing fixtures. b. Describe energy efficient pumps, systems and controls. c. Explain water reuse and recycling.
<p>15. Communication</p>	<ul style="list-style-type: none"> a. Demonstrate effective verbal and written communication skills in the plumbing classroom, lab, and workplace.
<p>16. Leadership and Teamwork</p>	<ul style="list-style-type: none"> a. Demonstrate an ability to work independently and as a collaborative team member in the plumbing industry.
<p>17. Ethics and Legal Responsibilities</p>	<ul style="list-style-type: none"> a. Recognize the professional and ethical standards that are required in the plumbing industry.
<p>18. Career Development</p>	<ul style="list-style-type: none"> a. Explore the various sectors and trade options in the plumbing industry and the apprenticeship/training process for plumbers; identify the various career paths available to plumbers (including journeyman, foreperson, superintendent, project manager, estimator, engineer, etc.). b. Recognize the financial, managerial and legal factors important in operating a sole proprietor, subchapter S, or LLC plumbing business.

VT Electrical, HVAC, Plumbing CTE Program - Academic Alignment with [VT Content Area Graduation Proficiencies \(PBGRs\)](#)

Graduation Proficiencies:	Indicators:
English Language Arts	High School 1. Reading: b, c, d, g 2. Writing: a, b, e 3. Writing: c 4. Speaking and Listening: a, b 5. Speaking and Listening: a, b, d 6. Language: a, c, e
Mathematics	High School 1. Modeling: a, b, f 2. Number and Quantity: b, c 5. Geometry: d, h, l, m, n
Science	High School 1. Physical Sciences: Structure/Properties of Matter, Forces, and Interactions: k 2. Physical Sciences: Energy, Waves, and Electromagnetic Radiation: a, d 8. Engineering, Technology, and Application of Science: d, e
Global Citizenship/Social Studies	End of Gr. 12 Inquiry: Constructing compelling and supporting questions: a; Determining helpful sources: a Civics: Processes, Rules, and Laws: a Economics: Economic Decision Making: a; Exchange and Markets: a Geography: Human Environment Interaction: Place, Regions, and Culture: a Communicating Conclusions and Taking Informed Action: Communicating: b

VT Electrical, HVAC, Plumbing CTE Program Elements

Demonstration and Application:	Available Options:
Dual Enrollment/Fast Forward Courses	CCV: Intro to Business (BUS-1010-VC50), Startup 802: An Entrepreneurial Mindset (BUS-1125-VC50)
Industry Recognized Credentials (IRCs)	<p>Tier 1:</p> <ul style="list-style-type: none"> ● American Heart Association - CPR or CPR/AED ● American Heart Association - First Aid ● American Heart Association - First Aid, CPR/AED ● American Red Cross - CPR/AED ● American Red Cross - First Aid ● American Red Cross - First Aid, CPR/AED ● OSHA 10 ● OSHA 30 ● Vermont Department of Motor Vehicles - Commercial Driver's License Permit <p>Tier 2:</p> <ul style="list-style-type: none"> ● ESCO Institute - EPA Section 608 Certification ● National Center for Construction Education and Research (NCCER) - Core ● National Center for Construction Education and Research (NCCER) - Electrical Level 1 ● National Center for Construction Education and Research (NCCER) - Electrical Level 2 ● National Center for Construction Education and Research (NCCER) - HVAC 1 ● National Center for Construction Education and Research (NCCER) - HVAC 2 ● National Center for Construction Education and Research (NCCER) - Plumbing 1 ● National Center for Construction Education and Research (NCCER) - Plumbing 2 ● National Oilheat Research Alliance (NORA) Bronze Oilheat Certification ● The Fiber Optic Association (FOA) Certified Fiber Optic Technician ● Vermont Department of Labor Registered Apprenticeship Program - Electrical Apprenticeship Year 1 Exam ● Vermont Department of Labor Registered Apprenticeship Program - Electrical

Demonstration and Application:	Available Options:
	<p>Apprenticeship Year 2 Exam</p> <ul style="list-style-type: none"> • Vermont Department of Labor Registered Apprenticeship Program - Plumbing <p>Apprenticeship Year 1 Exam</p> <ul style="list-style-type: none"> • ACT National Career Readiness Certificate - Levels 5, 6, or 7
National Career Technical Student Organizations (CTSOs)	SkillsUSA
Work-Based Learning/Co-op (WBL)	<p>Varies by CTE Center</p> <ul style="list-style-type: none"> • VT Registered Apprenticeship: Electrical, Plumbing
Entrepreneurship Opportunities	Varies by CTE Center
Portfolio/Personalized Learning Plan (PLP)	Varies by CTE Center