

## Colorado CTE Course – Scope and Sequence

<b>Course Name</b>	<b>Plumbing Technology</b>		<b>Course Details</b>	<b>Credit= 1.0</b>	
			Course = 0.50 Carnegie Unit Credit	<b>Prerequisite: Principles of Construction or Mechanical, Electrical, and Plumbing Systems</b>	
				<b>CTE Credential: CTE Architecture and Construction</b>	
<b>Course Description</b>	As an introductory course to plumbing technology, this class focuses on understanding general concepts of the construction industry. Students study the role of plumbing in construction. Skills are developed in plumbing fundamentals such as basic drainage system structures, water supply and code requirements.				
<b>Note:</b>	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.				
SCED Identification #	17058	Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.			
All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at <a href="https://www.cde.state.co.us/standardsandinstruction/essentialskills">https://www.cde.state.co.us/standardsandinstruction/essentialskills</a>					
Instructional Unit Topic	Suggested Length of Instruction	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
<b>Safety</b>		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 Building and Construction Trades sector workplace environment	Practice safe work habits. Student is expected to: (A) Interpret policies, procedures, and regulations for the workplace environment, including employer and employee responsibilities. (B) use health and safety practices for storing, cleaning, and maintaining tools, equipment, and supplies.	Identify safety hazards on a jobsite and demonstrate practices for safe working. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ	

			<p>(C) set up a work area, or shop, to avoid potential health concerns and safety hazards, including but not limited to electrical (shock), wires (tripping), fumes (lung health), noise (hearing loss), fire (burns), and so forth, incorporating ergonomics.</p> <p>(D) maintain a safe and healthful working environment; and</p> <p>(E) comply with the safe handling, storage and disposal of chemicals, materials and adhesives in accordance with local, state, and federal safety and environmental regulations (OSHA, Environmental Protection Agency [EPA], Hazard Communication [HazCom], Safety Data Sheets [SDS], etc.).</p>	<p>universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures.</p> <p>Continue to maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety &amp; Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and</p>	
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				<p>equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy.</p> <p>Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (SDS). For example, obtain an SDS for a given material from a supplier in the community.</p> <p>Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment. Describe hazards involved with plumbing work, including working in confined spaces.</p>	
<b>Career Development</b>		Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.	The student demonstrates professional standards/employability skills as required by business and industry.	Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses.	<p>Updates to ICAP</p> <p>SkillsUSA Personal and Employability</p>

			<p>The student is expected to:</p> <p>(A) identify job opportunities with their accompanying job duties in occupations such as plumber, building maintenance technician or manager, and inspector; and</p> <p>(B) research career pathways along with the education, job skills, and experience required to achieve a career goal.</p>	<p>Create a portfolio of work accomplished. Include photographs or illustrations and written descriptions of sequential progress in construction projects.</p> <p>Research local job and internship opportunities and requirements. Update resume and practice job interview skills.</p>	<p>Skills Framework</p> <p>SkillsUSA Plumbing Competition</p>
<b>Tool and Equipment</b>		<p>Select and use tools and equipment appropriately for plumbing systems service and repair applications.</p>	<p>Use plumbing tools appropriately. Student is expected to:</p> <p>(C) Identify and select the proper tools and accessories,</p> <p>(D) critique the readiness of the tools,</p> <p>(E) use the tools to accomplish the desired tasks, and</p> <p>(F) return tools and accessories to their proper storage.</p>	<p>Demonstrate use of plumbing tools:</p> <p>(Examples) Hand and power tools: Bladed Impact Power Electrically powered Liquid fuel Demolition saw Skill saw Reciprocating saw Power drill Gas detection meter Variety of drills (Portable electric, Offset, Cordless) Cordless multitool, Drill bits Die tool sets, Soldering tools Variety of wrenches, including: Pipe, Pipe tongs, Strap, Spud, Open-end, Adjustable, Basin Monkey, Torque, Pliers, Maul</p>	

				<p>Research a new technology recently developed for the plumbing industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency for a plumber.</p>	
<p><b>Plumbing Industry Regulations and Practices</b></p>		<p>Understand the regulatory environment that governs construction plumbing systems and standards.</p> <p>Understand common plumbing industry work environment and occupations.</p>	<p>Understand construction plumbing regulations and standard industry practices. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) identify the responsibilities of a person working in the plumbing;</li> <li>(B) identify the industries and associations that make up the modern plumbing profession</li> <li>(C) describe the purpose and importance of local, state, and federal heating, air conditioning, and refrigeration codes and standards.</li> </ul>	<p>Locate and assess requirements for performing plumbing work including local, state, and national requirements. Interpret plumbing codes, and determine inspection procedures and other applicable portions of the law. Visit the Colorado DORA's Licensing Board's website and analyze its policies and requirements. Explain how such policies impact local construction businesses as well as individuals.</p> <p>Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and</p>	

				relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client, describing the services provided and explaining the project delivery method used by the company.	
<b>Blueprints and Specifications</b>		Use construction blueprints and drawings to complete plumbing construction projects.	<p>Understand and apply construction drawings and blueprints to plumbing applications. Student is expected to:</p> <ul style="list-style-type: none"> <li>(A) identify the types of schedules and drawings used by the Plumbing industry;</li> <li>(B) understand plumbing drawings and symbols; and</li> <li>(C) understand the relationship between construction drawings and specifications for plumbing applications.</li> </ul> <p>The student identifies and draws hot and cold water lines on a floor plan using an isometric</p>	<p>Building on knowledge of construction drawings and specifications from Principles of Construction or Mechanical, Electrical, &amp; Plumbing Systems, examine plumbing drawings and identify common plumbing symbols used for the components of pipe assemblies. Read and interpret construction drawings, including detail drawings and equipment schedules, to create a list of materials needed for a given plumbing project. For example, analyze plumbing plans and isometric drawings to determine the materials needed to install a drain, waste, and vent system.</p> <p>Explain the relationship between construction</p>	

			<p>drawing. The student is expected to:</p> <p>(A) identify hot and cold water lines and their symbols on a floor plan;</p> <p>(B) demonstrate how to draw hot and cold water lines on a floor plan using an isometric drawing; and</p> <p>(C) demonstrate how to properly size a residential hot and cold water system.</p>	<p>drawings and specifications. Describe how both the construction drawings and specifications provide information about the plumbing system for a building. For example, examine construction drawings and specifications to determine the requirements of hangers and supports for a given plumbing piping system.</p> <p>Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI) as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product. Demonstrate the ability to use an architect's scale to measure a component of a scale drawing. Create drawings commonly used in the plumbing trade, including orthographic and isometric sketches.</p>	
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<p><b>Plumbing Math</b></p>		<p>Apply mathematics as they relate to plumbing applications and techniques.</p>	<p>The student applies knowledge and skills in mathematics as they relate to plumbing and the principles of drainage and ventilation. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) identify similar units of measurement in both English and the International System (SI) of units;</li> <li>(B) calculate and convert measured values and volumes expressed in mathematical equations and formulas; and</li> <li>(C) convert temperature values between Celsius and Fahrenheit.</li> </ul>	<p>Apply mathematics concepts to solve plumbing problems, distinguishing which principles apply to a given problem. Concepts should include, but are not limited to:</p> <ul style="list-style-type: none"> <li>a. Using the basic rules of right triangles, such as the 3-4-5 ratio, to lay out and check square corners.</li> <li>b. Calculating values associated with angles and triangles to determine the run, travel, and rise of an offset.</li> </ul>	
<p><b>Plastic Pipe and Fittings</b></p>		<p>Demonstrate skills necessary to fabricate and service the tubing, piping, and fittings utilized in accordance with accepted industry standards.</p>	<p>The student learns the types and schedules of plastic pipe and fittings used in plumbing applications, including acrylonitrile butadiene styrene or ABS, polyvinyl chloride or PVC, chlorinated polyvinyl chloride or CPVC, polyethylene or Poly pipe, crosslinked polyethylene or PEX, and</p>	<p>Building on the knowledge of plastic piping from Principles of Construction or Mechanical, Electrical, and Plumbing Systems, distinguish among different types of plastic plumbing pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of plastic pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards,</p>	



			<p>polybutylene. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) identify types of materials and schedules of plastic piping;</li> <li>(B) identify proper and improper applications of plastic piping;</li> <li>(C) identify types of fittings and valves used with plastic fittings;</li> <li>(D) identify and determine the kinds of hangers and supports needed for plastic piping;</li> <li>(E) identify the various techniques used in hanging and supporting plastic piping;</li> <li>(F) demonstrate how to measure, cut, and join the different types of plastic piping;</li> <li>(G) explain proper procedures for the handling, storage, and protection of plastic pipes; and</li> <li>(H) explain how code requirements apply</li> </ul>	<p>and procedures for cutting and joining various types of plastic plumbing pipe, including ABS, PVC, CPVC, PE, PEX, and PB. Create a list of the appropriate piping materials, tools, and equipment needed for a given plastic piping application including supports and spacing.</p> <p>Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install plastic pipe, including measuring, cutting, joining, and supporting plastic pipe. Utilize the appropriate tools, equipment, PPE, and procedures to safely complete installations. Once installed, pressure test plastic pipe according to local plumbing code to verify installation was properly completed.</p>	
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			to different types of plastic pipe.		
<b>Copper Pipe and Fittings</b>		Demonstrate skills necessary to fabricate and service the tubing, piping, and fittings utilized in accordance with accepted industry standards.	<p>The student understands the applications of copper pipe and fittings, the types of valves that can be used on copper pipe systems, and the methods for cutting, reaming, joining, and installing copper tubing. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) identify the different types of copper tubing;</li> <li>(B) identify the material properties and storage and handling requirements of copper tubing;</li> <li>(C) identify the types of fittings and valves used with copper tubing;</li> <li>(D) identify the various techniques used in hanging and supporting copper tubing;</li> <li>(E) demonstrate, using industry standards, how to safely solder copper tubing using</li> </ul>	<p>Distinguish among different types of copper tube, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of copper tube and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining various types of copper tube. Create a list of the appropriate piping materials, tools, and equipment needed for a given copper tubing application including supports and spacing.</p> <p>Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install copper tubing, including measuring, cutting, bending, joining, grooving, and supporting plastic pipe. Utilize the appropriate tools, equipment, PPE, and procedures to safely complete installations. Once installed, pressure test copper tube</p>	

			<p>different heat sources;</p> <p>(F) demonstrate how to measure, ream, and cut copper piping;</p> <p>(G) identify the hazards and safety precautions associated with copper piping; and</p> <p>(H) explain how code requirements apply to copper tubing.</p>	<p>according to local plumbing code to verify installation was properly completed.</p>	
<b>Cast Iron Pipe and Fittings</b>		<p>Demonstrate skills necessary to fabricate and service the tubing, piping, and fittings utilized in accordance with accepted industry standards.</p>	<p>Use information on cast iron piping for plumbing maintenance, installation, or repair services. Student is expected to:</p> <p>(A) understand the physical properties of cast iron piping; and</p> <p>(B) compare and contrast cast iron piping properties and installation techniques.</p>	<p>Distinguish among different types of cast-iron pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of cast-iron pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining hub-and-spigot cast-iron pipe and no-hub cast-iron pipe. Create a list of the appropriate piping materials, tools, equipment, and PPE needed for a given cast-iron piping application including selecting the correct supports and spacing.</p>	

				Demonstrate proper procedures to correctly measure, cut, and join cast-iron pipe utilizing the appropriate tools, equipment, and PPE. Describe testing procedures used to check cast iron piping for leaking joints, as designated in local plumbing code.	
<b>Carbon Steel Pipe and Fittings</b>		Demonstrate skills necessary to fabricate and service the tubing, piping, and fittings utilized in accordance with accepted industry standards.	<p>The student measures, cuts, threads, reams, joins, and hangs carbon steel pipe and becomes familiar with labeling and sizing carbon steel pipe. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) recognize proper applications of carbon steel piping;</li> <li>(B) identify the material properties, storage, and handling requirements of carbon steel piping;</li> <li>(C) identify the various techniques used in hanging and supporting carbon steel piping;</li> <li>(D) demonstrate how to measure, cut, ream, thread, and join carbon steel piping; and</li> </ul>	<p>Distinguish among different types of steel pipe, fittings, valves, hanging, and support. Draw on textual evidence and observations to describe the material properties of steel pipe and create guidelines for proper storage and handling requirements. Compare and contrast the tools, hazards, and procedures for cutting and joining steel pipe. Create a list of the appropriate piping materials, tools, and equipment needed for a given steel piping application including supports and spacing.</p> <p>Read and interpret manufacturer's instructions, construction drawings and specifications, and applicable codes to properly install steel pipe, including measuring, cutting, joining, and supporting steel pipe. Utilize</p>	

			(E) explain how code requirements apply to carbon steel pipe.	the appropriate tools, equipment, PPE, and procedures to safely complete installations.	
<b>Plumbing Fixtures</b>		Understand installation procedures for common plumbing fixtures.	<p>The student understands and applies how to install plumbing fixtures according to plumbing code. The student is expected to:</p> <p>(A) demonstrate how to install a toilet; and</p> <p>(B) demonstrate how to install sinks and different faucets.</p>	Describe the features and operating principles of various types of plumbing fixtures, including sinks, lavatories, faucets, bathtubs, showers, and toilets. Analyze the operational procedures of two different toilets, such as a siphon-action water toilet and a blow-out water toilet. Compare and contrast the functions and benefits of each, citing resources to make a recommendation for a client based on the specific needs of a project.	
<b>Drain, Waste, and Venting (DWV) Systems</b>		Understand how drain, waste, and vent systems remove waste safely.	<p>The student understands how pipes, drains, traps, and vents work and the different types of materials used for drain waste and vent (DWV) piping. The student is expected to:</p> <p>(C) explain how waste moves from a fixture through the drain system to the public or private sewer system;</p> <p>(D) identify the major components of a</p>	Study a schematic plan of a typical community sewer system. Citing evidence from a technical description or actual observation of a system, explain how waste moves through a drain, waste, and vent system from the fixture to the environment. Create a graphic illustration to represent the movement of waste from one component to the others in the system. For example, create a basic diagram of how the waste generated by a clean-up sink	

			<p>drainage system and describe their functions;</p> <p>(E) identify the different types of traps and their components, explain the importance of traps, and identify the ways that traps can lose their seals;</p> <p>(F) identify the various types of drain, waste, and vent fittings and describe their applications;</p> <p>(G) identify significant code and health issues, violations, and consequences related to drain, waste, and vent systems;</p> <p>(H) identify DWV symbols and lines on an isometric drawing and a floor plan;</p> <p>(I) demonstrate how to draw an isometric DWV system to make a materials list;</p> <p>(J) recognize and explain the use of different pipe and fitting materials used for DWV piping and how</p>	<p>in the classroom travels to the local sewage treatment plant.</p> <p>Demonstrate understanding of the specific roles of various plumbing components in a drain, waste, and vent system by sketching a system model. Label the components, and include a written description of the function of each. Be able to describe the physical principles involved such as gravity and pressure.</p> <p>Analyze the function of a trap by examining a drain, waste, and vent system whose trap has lost its seal. Diagnose and explain the cause and determine the appropriate solution, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is preferable or more effective than another.</p>	
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			<p>they are assembled; and</p> <p>(K) understand how code requirements apply to DWV systems.</p> <p>The student describes and demonstrates the different types of valves and their uses. The student is expected to:</p> <p>(A) explain why and where open-close valves are used;</p> <p>(B) explain why and where flow regulation valves are used;</p> <p>(C) explain why and where pressure reducing valves are used; and</p> <p>(D) explain why and where pressure and vacuum relief valves are used.</p>		
<b>Water Distribution Systems</b>		Understand the distribution systems for water and waste in residential and commercial construction.	The student identifies major components of a municipal water system and how water is distributed to residential or commercial houses or	Study a schematic plan of a typical municipal water distribution system. Citing evidence from a technical description or actual observation of a system, explain how water travels from a water treatment plant	

			<p>buildings. The student is expected to:</p> <ul style="list-style-type: none"> <li>(A) describe and explain the earth's water cycle;</li> <li>(B) describes different water sources;</li> <li>(C) describe and show how water gets from the water well or water meter to the house or building; and</li> <li>(D) discuss and explain different types of valves and devices found in a residential or commercial water system.</li> </ul>	<p>to a fixture in a residence. Create a graphic illustration to represent the movement of water from one component to the others in the system. For example, sketch an isometric drawing of a simple water distribution system and label its components.</p>	
<b>Basic Repair and Maintenance</b>		<p>Identify routine maintenance and basic repairs for the plumbing industry.</p> <p>Demonstrate the skills necessary to service, maintain, and repair plumbing system components and accessories</p>	<p>Student is expected to:</p> <ul style="list-style-type: none"> <li>(A) use problem-solving strategies for determining appropriate plumbing repair processes; and</li> <li>(B) identify routine maintenance for plumbing or waste systems.</li> </ul>	<p>Identify and demonstrate basic troubleshooting strategies appropriate for evaluating plumbing systems and devices. For example, in a drain system, develop and implement a troubleshooting strategy to test and remedy a clogged drain.</p> <p>Identify routine maintenance procedures that should be performed on plumbing systems for a given building. Create a timeline of recommended maintenance</p>	



				procedures for a client, justifying why each procedure is necessary by highlighting its preventive or cost-efficient characteristics. For example, create a schedule of items to inspect and clean in order to keep a water heater running efficiently.	
<b>Green Practices in Plumbing</b>		Understand and apply environmentally friendly and sustainable industry work practices.	The student understands and demonstrates what green technology is and how it relates to the plumbing profession and environment. The student is expected to: <ul style="list-style-type: none"> <li>(A) identify different green plumbing fixtures;</li> <li>(B) identify different types of reuse plumbing systems; and</li> <li>(C) design and demonstrate a particular reuse water plumbing system.</li> </ul>	Define the term efficiency in the context of the plumbing profession and plumbing systems. Research and identify strategies used in the design of plumbing systems and plumbing work practices to increase the efficiency of plumbing systems. Drawing on resources such as those from the U.S. Green Building Council and EPA Energy Star, create a recommendation for a client outlining green plumbing strategies for a given building.	
<b>Business and Project Management Practices</b>		Acquire and accurately use Building and Construction Trades sector terminology and protocols at the career and college readiness level for communicating	Apply knowledge of business industry practices. Student is expected to:	Describe the components and purpose of a basic contract document for a residential project, determining the meaning of key terms and other industry-specific words.	

		<p>effectively in oral, written, and multimedia formats.</p> <p>Understand best practices for managing business communications and projects.</p>	<p>(A) investigate business practices for contract services; and</p> <p>(B) identify common practices for effective communication in the workplace for individuals and teams.</p>	<p>Recognize the relationship and responsibilities of various parties to a contract. Write a basic contract for a job, such as a plumbing service agreement for work done for a residential client.</p> <p>Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals.</p> <p>Interpret construction drawings and applicable local plumbing codes to determine the correct materials, tools, and equipment needed to complete a plumbing project. Plan and implement the steps needed to complete the</p>	
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				<p>project, adhering to inspection procedures and employing safe practices throughout. Draw from print and electronic examples to create a material list, cost estimation, project schedule, and inspection checklist for a project, applying the components of the documents to the given project.</p> <p>Produce clear and coherent writing for communication in the plumbing industry. Create a service order for a given plumbing project. Explain the service order to a peer, as would a service technician to a client.</p> <p>Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during plumbing projects as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule.</p>	
