

Plumbing Technology



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The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Plumbing Technology Program of Study. The academic standards in this document are theoretical and performance-based. The standards contain content from Colorado, Maryland, Tennessee, and Texas and were validated by D.C. business and industry partners. All content is used with permission.

In addition to academic standards, OSSE has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; Work-Based Learning resources and requirements by course level; and a recommended equipment and supply list.

This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.



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Course Descriptions: Plumbing Technology

Course Level	Course Information	Description
Level I	Principles of Construction OSSEID: 17002G1.0014 Grades: 9-12 Prerequisite: None Credit: 1	Principles of Construction is intended to provide an introduction and lay a solid foundation for those students entering the construction or craft skilled areas. The course provides a strong knowledge of construction safety, construction mathematics, and common hand and power tools. This course also provides communication and occupation skills to assist the student in obtaining and maintaining employment.
Level II	Plumbing Technology I OSSEID: 17058G1.0024 Grades: 10-12 Prerequisite: Principles of Construction Credit: 1	In Plumbing Technology I, students will gain knowledge and skills needed to enter the industry as a plumbing apprentice, building maintenance technician, or supervisor or prepare for a postsecondary degree in construction management, architecture, or engineering. Students will acquire knowledge and skills in industry workplace basics and employer/customer expectations, including how to use a plumbing code book; how to identify and use power and hand tools; how to be safe on the jobsite and when using hand and power tools; how to apply basic plumbing mathematics and plumbing drawing; and how to identify, fit, and use plastic, copper, cast iron, carbon steel, and corrugated stainless steel pipe. In addition, students will be introduced to gas, drainage, and water supply systems and continue their knowledge of workplace basics and green technologies.
Level III	Plumbing Technology II OSSEID: 17058G1.0034 Grades: 11-12 Prerequisite: Plumbing Technology I Credit: 1	In Plumbing Technology I, students will gain knowledge and skills needed to enter the industry as a plumbing apprentice, building maintenance technician, or supervisor or prepare for a postsecondary degree in construction management, architecture, or engineering. Students will acquire knowledge and skills in industry workplace basics and employer/customer expectations, including how to use a plumbing code book; how to identify and use power and hand tools; how to be safe on the jobsite and when using hand and power tools; how to apply basic plumbing mathematics and plumbing drawing; and how to identify, fit, and use plastic, copper, cast iron, carbon steel, and corrugated stainless steel pipe. In addition, students will be introduced to gas, drainage, and water supply systems and continue their knowledge of workplace basics and green technologies.



Level IV	Practicum in Construction Technology OSSEID: 17951G1.0044 Grades: 12 Prerequisite: Plumbing Technology II Credit: 1	In Practicum in Construction Technology, students will be challenged with the application of knowledge and skills gained in previous construction-related coursework. In many cases, students will be allowed to work at a job (paid or unpaid) outside of school or be involved in local projects the school has approved for this class.
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Industry Certifications

OSHA 10
 ACCA (Air Conditioning Contractors of America) Refrigerant Handling (EPA 608)
 NCCER HVAC, Level 1
 EPA HVAC Certification

Work-Based Learning Examples and Resources

Level I Course	Level II Course	Level III Course	Level IV Course
Career Exploration Industry Visits Guest Speakers Participate in a CTSO	Career Awareness <i>All of Level I, plus:</i> Postsecondary Visits Program- Specific Site Tours Mock Interviews	Career Preparation <i>All of Level I and II, plus:</i> Job Shadow Paid/Unpaid Internships	Career Preparation Paid/Unpaid Internships Apprenticeships

Several resources are available to help instructors meet the Level I and Level II WBL requirements, including:

Career Coach DC (<http://careercoachdc.emsicc.com>). Online site designed to help students find and connect to a career pathway by providing the most current local data on wages, employment, job postings, and associated education and training. The resource includes a Career Assessment for students.

Nepris (<https://dc.nepris.com/>). Connects educators and learners with a network of industry professionals virtually, bringing real-world relevance and career exposure to all students. Nepris also provides a skills-based volunteering platform for business and industry professionals to extend their educational outreach.

Virtual Job Shadow (<https://virtualjobshadow.com>). Provides interactive tools which empower students to discover, plan, and pursue their dreams. Rich video library presents a “day in the life of” view for thousands of occupations.

Labor Market Information Definitions and Data

Career and Technical Education programs of study in the District of Columbia must meet at least one of the High Wage, High Skill, and In-Demand definitions below to be considered appropriate for our students and the regional labor market. These definitions were created in collaboration with Career and Technical Education leaders from District of Columbia LEAs, the University of the District of Columbia Community College, and national guidance from Research



Triangle International (RTI) and Education Northwest. Additionally, previous work was consulted by researchers at MIT's Labor Wage Index Project and the DC CTE Task Force's 2012 Strategic Plan for the District of Columbia

Indicator	Definition	Data for the Plumbing Program of Study (source: EMSI, August 2022)
<p>High Wage</p>	<p>Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the District of Columbia, and/or leads to a position that pays at least the median hourly or annual wage for the Washington, DC, metropolitan statistical area.</p> <p><i>Note: A 25th percentile hourly wage of \$23.13 or greater is required to meet this definition.</i></p>	<p>Standard Occupational Code (SOC): 47-2152.00 Plumbers, Pipefitters, and Steamfitters</p> <p>Hourly Wages 25th Percentile: \$22.94 50th Percentile: \$29.36 75th Percentile: \$37.13</p>
<p>High Skill</p>	<p>Those occupations located within the Washington, DC, metropolitan statistical area with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, or higher.</p>	<p>Typical Entry-Level Education: High School Diploma or Equivalent</p>
<p>In-Demand</p>	<p>Those occupations in the Washington, DC, metropolitan statistical area having more than the median number of total (growth plus replacement) annual openings over a five-year period.</p> <p><i>Note: An occupation is required to have an annual growth plus replacement rate of 105 openings, or greater, between 2021-2026 to meet this definition.</i></p>	<p>Annual Openings: 1,679</p>

Industry Certifications

- OSHA 10
- NCCER (National Center for Construction Education and Research) Plumbing, Level 1
- NCCER (National Center for Construction Education and Research) Plumbing, Level 2



Model Six-Year Plan: Plumbing Technology

College: University of the District of Columbia Community College

Program/CIP:

Plan:

Entity: Office of the State Superintendent of Education

Career Cluster: Architecture and Construction

Program of Study: Plumbing Technology

High School					College			
Subject	9 th Grade	10 th Grade	11 th Grade	12 th Grade	Semester I	Semester II	Semester III	Semester IV
English (4)	English I	English II	English III	English IV				
Math (4)	Algebra I	Geometry	Algebra II	Math				
Science (4)	Biology	Lab Science	Lab Science	Science				
Social Studies (4)	World History and Geography I: Middle Ages	World History and Geography II: Modern World	U.S. History	U.S. Government (.5) and D.C. History (.5)				
Health (.5) and Physical Ed (1)	Health (.5) Physical Ed (.5)	Physical Ed (.5)						
World Languages (2)			World Language I	World Language II				
Art (.5)		Art (.5)						
Music (.5)		Music (.5)						
Elective / Major Courses	Principles of Construction	Plumbing Technology I	Plumbing Technology II	Practicum in Construction Technology				
Total possible college credits completed in high school: XX					Credit hours required to complete the AAS program: XX			



Course Standards

Principles of Construction

0. **General requirements.** This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.
1. **Introduction.**
- A. Career and technical education instruction provides students with industry-aligned content, challenging academic standards, and relevant technical knowledge to further their education and succeed in current or emerging professions.
 - B. The Architecture and Construction Career Cluster focuses on designing, planning, managing, building, and maintaining the built environment.
 - C. Principles of Construction is intended to provide an introduction and lay a solid foundation for those students entering the construction or craft-skilled areas. The course provides a strong knowledge of construction safety, construction mathematics, and common hand and power tools. For safety and liability considerations, limiting course enrollment to 15 students is recommended. This course also provides communication and occupation skills to assist the student in obtaining and maintaining employment.
 - D. Students will participate in at least two Career Exploration Work-Based Learning experiences in this course, which might include guest speakers and workplace tours relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
2. **Knowledge and skills.**
- A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
 - 1. explain the role of an employee in the construction industry;
 - 2. demonstrate critical-thinking skills;
 - 3. demonstrate the ability to solve problems using critical-thinking skills;
 - 4. demonstrate knowledge of basic computer systems;
 - 5. explain common uses for computers in the construction industry;
 - 6. define effective relationship skills;
 - 7. recognize workplace issues such as sexual harassment, stress, and substance abuse;
 - 8. explain the Occupational Safety and Health Administration (OSHA) General Duty Clause; and
 - 9. explain OSHA 1926 CFR Subpart C.
 - B. **The student understands that safe working standards are imperative in the classroom and in the field. The student is expected to:**
 - 1. explain the idea of a safety culture;
 - 2. explain the importance of a safety culture in the construction crafts;
 - 3. explain the role of the OSHA in job-site safety;



4. explain fall protection, ladder safety, stair safety, and scaffold safety procedures;
 5. demonstrate the use and care of appropriate personal protective equipment, including safety goggles and glasses, hard hats, gloves, safety harnesses, and safety shoes;
 6. define safe work procedures around electrical hazards; and
 7. explain the importance of Safety Data Sheets (SDS).
- C. **The student understands the importance of recognizing potential hazards and preventing accidents in the classroom and in the field. The student is expected to:**
1. identify causes of accidents;
 2. identify impacts of accident costs;
 3. define hazard recognition;
 4. identify struck-by hazards;
 5. identify caught-in-between hazards;
 6. identify other construction hazards on the jobsite, including hazardous material exposures, environmental elements, welding and cutting hazards, confined spaces, and fires; and
 7. explain the importance of hazard communication (HazCom).
- D. **The student understands basic construction mathematics. The student is expected to:**
1. add, subtract, multiply, and divide whole numbers with and without a calculator;
 2. add, subtract, multiply, and divide fractions;
 3. add, subtract, multiply, and divide decimals with and without a calculator;
 4. convert decimals to percentages and percentages to decimals; and
 5. convert fractions to decimals and decimals to fractions.
- E. **The student demonstrates basic measuring practices. The student is expected to:**
1. use a standard ruler, a metric ruler, a measuring tape, and an architectural/engineering scale to measure;
 2. explain what the metric system is and how it is important in the construction trade;
 3. recognize and use metric units of length, weight, volume, and temperature; and
 4. recognize some of the basic shapes used in the construction industry and apply basic geometric principles to measure them.
- F. **The student acquires knowledge about the care and identification of hand tools. The student is expected to:**
1. recognize and identify the basic hand tools and their purposes for the construction trades;
 2. inspect basic hand tools visually to determine if they are safe for use; and
 3. use the basic construction hand tools safely and properly.
- G. **The student acquires knowledge about care and identification of powered hand tools. The student is expected to:**
1. identify powered hand tools commonly used in the construction trades;
 2. practice safe and proper application of powered hand tools commonly used in the construction trades; and
 3. explain how to properly maintain and clean powered hand tools commonly used in construction trades.
- H. **The student develops the basics of construction drawing. The student is expected to:**
1. interpret and use drawing dimensions;
 2. recognize and identify basic construction terms;



3. recognize and identify basic drawing components;
 4. recognize and identify commonly used drawing symbols;
 5. relate information on construction drawings to actual locations on the print; and
 6. recognize different classifications of construction drawings.
- I. **The student reads technical drawings and documents to plan a project. The student is expected to:**
1. interpret blueprints and drawings to assist with project planning;
 2. recognize elements and symbols of blueprints and drawings;
 3. relate information on blueprints to actual locations on the print;
 4. recognize different classifications of drawings; and
 5. interpret and use drawing dimensions.
- J. **The student interprets and presents information used in workplace situations. The student is expected to:**
1. interpret information and instructions presented in written form;
 2. interpret information and instructions presented in verbal form;
 3. communicate effectively using verbal and writing skills; and
 4. communicate effectively on the job using electronic communication devices.
- K. **The student identifies ergonomic tools and procedures as well as safe material handling standards. The student is expected to:**
1. define a load;
 2. establish a pre-task plan prior to moving a load;
 3. apply proper material-handling techniques;
 4. choose appropriate material-handling equipment for the task; and
 5. recognize hazards and follow safety procedures required for material handling.
- L. **The student develops technology skills. The student is expected to:**
1. Use technology as a tool to research, organize, evaluate, and communicate information;
 2. Use digital technologies (computers, PDAs, media players, GPSs, etc.); communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy;
 3. Demonstrate using current and new technologies specific to the program of study, course, and/or industry; and
 4. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.



Plumbing Technology I

1. **General requirements.** This course is recommended for students in Grades 10-12. Prerequisite: Principles of Construction. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides students with industry-aligned content, challenging academic standards, and relevant technical knowledge to further their education and succeed in current or emerging professions.
 - B. The Architecture and Construction Career Cluster focuses on designing, planning, managing, building, and maintaining the built environment.
 - C. In Plumbing Technology I, students will gain knowledge and skills needed to enter the industry as a plumbing apprentice, building maintenance technician, or supervisor or prepare for a postsecondary degree in construction management, architecture, or engineering. Students will acquire knowledge and skills in industry workplace basics and employer/customer expectations, including how to use a plumbing code book; how to identify and use power and hand tools; how to be safe on the jobsite and when using hand and power tools; how to apply basic plumbing mathematics and plumbing drawing; and how to identify, fit, and use plastic, copper, cast iron, carbon steel, and corrugated stainless steel pipe. In addition, students will be introduced to gas, drainage, and water supply systems and continue their knowledge of workplace basics and green technologies.
 - D. Students will participate in at least two Career Awareness Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and skills.**
 - A. The student is expected to demonstrate professional standards/employability skills as required by business and industry. The student is expected to:
 1. demonstrate oral communication, written communication, leadership skills, teamwork skills, conflict management, customer service, professionalism, work ethic, integrity, multitasking, initiative, creativity, and how to follow directions;
 2. understand the importance of showing up to work on time, maintaining appropriate personal appearance, working as a team member, and being honest;
 3. demonstrate an understanding of the responsibilities of driving a company vehicle;
 4. demonstrate an understanding of why and how listening is a critical life skill; and
 5. demonstrate an understanding of the importance of being a self-starter and of increasing one's knowledge and skills in a chosen career field.



- B. The student understands the causes of accidents and their consequences and repercussions in terms of delays, increased expenses, injury, and loss of life. The student is expected to:**
1. describe the common unsafe acts and conditions that cause accidents;
 2. describe how to handle unsafe acts and conditions;
 3. explain the impact and cost of accidents and illnesses;
 4. demonstrate the use and care of appropriate personal protective equipment;
 5. identify job-site hazards specific to plumbers;
 6. demonstrate the proper use of ladders;
 7. explain how to work around a trench;
 8. describe and demonstrate the lockout/tagout process; and
 9. understand the purpose of material safety data sheets (MSDS) and their importance to job-site and personal safety.
- C. The student understands and demonstrates what employer and customer expectations are and is familiar with industry workplace basics and their importance. The student is expected to:**
1. identify job opportunities and their accompanying job duties such as a plumber, building maintenance technician or supervisor, manager, and mechanical engineer;
 2. research careers along with the education, job skills, and experience required to achieve career goals;
 3. identify the industries and associations that make up the modern plumbing profession;
 4. demonstrate how to properly treat company and customer property;
 5. understand the importance of keeping the work area clean and how that applies to job safety; and
 6. understand the importance of using industry standards and techniques for the job.
- D. The student understands and demonstrates what green technology is and how it relates to the plumbing profession and environment. The student is expected to:**
1. identify different green plumbing fixtures;
 2. identify different types of reuse plumbing systems; and
 3. design and demonstrate a particular reuse water plumbing system.
- E. The student selects and safely uses different types of hand and power tools related to a specific task. The student is expected to:**
1. identify the hand and power tools used in the plumbing industry;
 2. demonstrate the proper use of hand and power plumbing tools;
 3. demonstrate the ability to know when and how to select the proper tools for tasks;
 4. demonstrate proper maintenance and care for hand and power tools;
 5. demonstrate how to prepare a surface for tool use;
 6. describe the safety requirements for using plumbing tools; and
 7. identify and demonstrate how to read and use various rulers and measuring tools.
- F. The student applies mathematical concepts to whole numbers, fractions, decimals, and squared numbers and examines how these concepts apply to specific situations. The student is expected to:**
1. add, subtract, multiply, and divide whole numbers, fractions, and decimals;
 2. convert fractions to decimals and decimals to fractions;
 3. demonstrate mathematical competency in the metric system and how the metric system is used in the plumbing industry;



4. square various numbers and determine the square roots of numbers with and without a calculator;
 5. identify and demonstrate the parts of a plumbing fitting and use common pipe-measuring techniques;
 6. use fitting dimensions tables to determine fitting allowances and thread makeup; and
 7. demonstrate how to measure end-to-end, center-to-center, and end-to-center measurements using fitting allowances and thread makeup.
- G. **The student learns the various types of drawings used in the plumbing industry to layout and install plumbing systems. The student is expected to:**
1. use current architectural technology to identify pictorial, isometric and oblique, schematic, and orthographic drawings and discuss how different views are used to depict information about objects;
 2. identify the basic symbols used in schematic drawings of pipe assemblies;
 3. explain the types of drawings that may be included in a set of plumbing drawings and the relationship among the different drawings;
 4. interpret plumbing-related information from a set of drawings;
 5. demonstrate how to sketch orthographic drawings;
 6. demonstrate the use of an architect's scale to draw lines to scale and to measure lines drawn to scale; and
 7. explain how code requirements apply to certain drawings.
- H. **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, cross-linked polyethylene or PEX, and polybutylene. The student is expected to:**
1. identify types of materials and schedules of plastic piping;
 2. identify proper and improper applications of plastic piping;
 3. identify types of fittings and valves used with plastic fittings;
 4. identify and determine the kinds of hangers and supports needed for plastic piping;
 5. identify the various techniques used in hanging and supporting plastic piping;
 6. demonstrate how to measure, cut, and join the different types of plastic piping;
 7. explain proper procedures for the handling, storage, and protection of plastic pipes; and
 8. explain how code requirements apply to different types of plastic pipes.
- I. **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:**
1. identify the different types of copper tubing;
 2. identify the material properties and storage and handling requirements of copper tubing;
 3. identify the types of fittings and valves used with copper tubing;
 4. identify the various techniques used in hanging and supporting copper tubing;
 5. demonstrate, using industry standards, how to safely solder copper tubing using different heat sources;
 6. demonstrate how to measure, ream, and cut copper piping;
 7. identify the hazards and safety precautions associated with copper piping; and
 8. explain how code requirements apply to copper tubing.



- J. **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:**
1. recognize proper applications of carbon steel piping;
 2. identify the material properties, storage, and handling requirements of carbon steel piping;
 3. identify the various techniques used in hanging and supporting carbon steel piping;
 4. demonstrate how to measure, cut, ream, thread, and join carbon steel piping; and
 5. explain how code requirements apply to carbon steel pipe.
- K. **The student gains knowledge and skills to connect and install corrugated stainless-steel tubing in various installation conditions. The student is expected to:**
1. identify the common manufacturers of corrugated stainless-steel tubing;
 2. recognize proper and improper applications of corrugated stainless-steel tubing;
 3. identify the various techniques used in hanging and supporting corrugated stainless-steel tubing;
 4. demonstrate how to measure, cut, and join corrugated stainless-steel tubing;
 5. identify the material properties, storage, and handling requirements of corrugated stainless-steel tubing; and
 6. explain how code requirements apply to corrugated stainless steel tubing.
- L. **The student understands the way drain, waste, and vent systems remove waste safely. 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:**
1. explain how waste moves from a fixture through the drain system to the public or private sewer system;
 2. identify the major components of a drainage system and describe their functions;
 3. identify the different types of traps and their components, explain the importance of traps, and identify the ways that traps can lose their seals;
 4. identify the various types of drain, waste, and vent fittings and describe their applications;
 5. identify significant code and health issues, violations, and consequences related to drain, waste, and vent systems;
 6. identify DWV symbols and lines on an isometric drawing and a floor plan;
 7. demonstrate how to draw an isometric DWV system to make a materials list;
 8. recognize and explain the use of different pipe and fitting materials used for DWV piping and how they are assembled; and
 9. understand how code requirements apply to DWV systems.
- M. **The student identifies major components of a municipal water system and how water is distributed to residential or commercial houses or buildings. The student is expected to:**
1. describe and explain the earth's water cycle;
 2. describes different water sources;
 3. describe and show how water gets from the water well or water meter to the house or building; and
 4. discuss and explain different types of valves and devices found in a residential or commercial water system.



- N. **The student identifies and draws hot and cold water lines on a floor plan using an isometric drawing. The student is expected to:**
1. identify hot and cold water lines and their symbols on a floor plan;
 2. demonstrate how to draw hot and cold water lines on a floor plan using an isometric drawing; and
 3. demonstrate how to properly size a residential hot and cold water system.
- O. **The student describes and demonstrates the different types of valves and their uses. The student is expected to:**
1. explain why and where open-close valves are used;
 2. explain why and where flow regulation valves are used;
 3. explain why and where pressure reducing valves are used; and
 4. explain why and where pressure and vacuum relief valves are used.
- P. **The student develops technology skills. The student is expected to:**
1. Use technology as a tool to research, organize, evaluate, and communicate information;
 2. Use digital technologies (computers, PDAs, media players, GPSs, etc.); communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy;
 3. Demonstrate using current and new technologies specific to the program of study, course, and/or industry; and
 4. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.



Plumbing Technology II

1. **General requirements.** This course is recommended for students in Grades 11 and 12. Prerequisite: Plumbing Technology I. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides students with industry-aligned content, challenging academic standards, and relevant technical knowledge to further their education and succeed in current or emerging professions.
 - B. The Architecture and Construction Career Cluster focuses on designing, planning, managing, building, and maintaining the built environment.
 - C. In Plumbing Technology II, students will gain the advanced knowledge and skills needed to enter the industry as a plumber, building maintenance technician, or supervisor or prepare for a postsecondary degree in mechanical engineering. Students will acquire knowledge and skills in plumbing codes, industry workplace basics, and employer/customer expectations, including tool and jobsite safety, advanced plumbing mathematics, commercial drawings, basic electricity, hanger installation, supports, and structural penetrations, roof drains, fixture installation, valves and faucets, and oxy-fuel safety. Students will also learn about setup, cutting, brazing, and welding water system sizing, gas, drain, waste, and vent installation and testing, and water heater installation.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and skills.**
 - A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
 1. use industry standards to demonstrate oral communication, written communication, leadership, teamwork, conflict management, customer service, professionalism, work ethic, integrity, multitasking, initiative, creativity, and how to follow directions;
 2. demonstrate an understanding of the importance of showing up to work on time, maintaining appropriate personal appearance, working as a team member, and being honest;
 3. demonstrate an understanding of the responsibilities of driving a company vehicle;
 4. demonstrate an understanding of why and how listening is a critical skill; and
 5. demonstrate an understanding of the importance of being a self-starter and of increasing one's knowledge and skills in a chosen career field.



- B. The student identifies and demonstrates the use of hand and power tools such as pipe wrenches; rulers; measuring devices, drill bits; pipe stands; pipe vises; levels; pipe fabrication tools, and pipe cutting, threading, and reaming tools. The student is expected to:**
1. demonstrate how to measure with a 6-foot folding rule and 25-foot measuring tape;
 2. read and use rulers and measuring devices;
 3. demonstrate how to measure end-to-end, center-to-center, and end-to-center pipe measurements; and
 4. identify and safely demonstrate the use of selected hand and power tools.
- C. The student understands the different types of drill bits used in the plumbing profession. The student is expected to:**
1. explain the differences among and applications for masonry, twist steel, hole saw, paddle, and self-feeding wood bits; and
 2. demonstrate the use and application of masonry, twist steel, hole saw, paddle, and self-feeding wood bits.
- D. The student applies algebra and geometry to solve plumbing-related problems. The student is expected to:**
1. demonstrate how to determine the volume of a cylinder;
 2. demonstrate how to determine volume and length measurements using cubic feet and yards;
 3. demonstrate how to determine fall and grades of a pipe;
 4. demonstrate how to calculate simple and rolling offsets on parallel runs using constants;
 5. demonstrate how to calculate pressure, velocity, friction, and flow; and
 6. size a water system based on velocity limitations and pressure drop.
- E. The student reviews employer and customer expectations. The student is expected to:**
1. identify job opportunities such as a plumber, building maintenance technician or supervisor, manager, and mechanical engineer and their accompanying job duties;
 2. research careers along with the education, job skills, and experience required to achieve career goals;
 3. identify the industries and associations that make up the modern plumbing profession;
 4. demonstrate an understanding of how to properly treat company and customer property;
 5. demonstrate an understanding of the importance of keeping the work area clean and how that applies to job safety; and
 6. demonstrate an understanding of the importance of using proper methods and techniques for the job being performed.
- F. The student understands and applies electrical testing equipment. The student is expected to:**
1. apply the use of a volt/ohmmeter to different kinds of plumbing equipment;
 2. install hangers and supports and make penetrations according to plumbing code;
 3. demonstrate an understanding of how to choose the right hanger for the application;
 4. choose and build pipe supports;
 5. demonstrate an understanding of code standards on structural penetrations; and
 6. size and install roof drains according to plumbing code.
- G. The student understands and applies how to install plumbing fixtures according to plumbing code. The student is expected to:**
1. demonstrate how to install a toilet; and
 2. demonstrate how to install sinks and different faucets.



- H. **The student learns plot plans, structural design, shop drawings, elevation drawings, as-built drawings, equipment arrangement drawings, pipe and instrumentation drawings, isometric drawings, and detail drawings. The student is expected to:**
1. identify types of drawings;
 2. identify and use drawing symbols associated with piping plans and details;
 3. create field sketches; and
 4. interpret drawing indexes and line lists.
- I. **The student installs, stores, and handles various types of valves. The student is expected to:**
1. identify types of valves that start and stop the flow;
 2. identify types of valves that regulate flow;
 3. identify valves that relieve pressure;
 4. identify valves that regulate the direction of flow;
 5. identify types of valve actuators;
 6. explain how to properly store and handle valves;
 7. explain valve locations and positions;
 8. explain the factors that influence valve selection; and,
 9. interpret valve markings and nameplate information.
- J. **The student understands and applies how to braze weld and cut with oxy-fuel torch. The student is expected to:**
1. demonstrate an understanding of different parts of oxy-fuel equipment;
 2. identify and implement the proper procedure for attaching and adjusting oxy-fuel pressure regulators, gauges, hoses, and torches to oxy-fuel bottles;
 3. identify and apply fillers and fluxes for soldering and brazing; and
 4. demonstrate an understanding of safety and safety equipment used with oxy-fuel equipment.
- K. **The student understands and applies how to size, install, and test a residential water piping system according to plumbing code. The student is expected to:**
1. identify what factors are critical for sizing a water system, such as water pressure, velocity, friction, and flow;
 2. identify what fixture units are and how they apply to size a water system;
 3. install a water piping system; and
 4. test a water piping system.
- L. **The student understands what cross-connections are and their degree of hazard, and how to protect against them. The student is expected to:**
1. identify different types of backflow such as gravity, back-pressure, and back-siphonage;
 2. demonstrate an understanding of the degree of hazard such as toxic, nontoxic, polluted, and contaminated; and
 3. demonstrate an understanding of cross-connection protection such as air gap, reduced pressure zone backflow preventer, double check valve assembly, pressure type vacuum breaker, and atmospheric type vacuum breaker.



- M. **The student understands and applies how to size, install, and test a natural gas system according to plumbing code. The student is expected to:**
1. identify the factors involved in sizing a natural gas system; and
 2. size, install and test a natural gas system using carbon steel pipe and corrugated stainless steel tubing.
- N. **The student understands how to size, install, and test a drain waste and vent (DWV) system according to plumbing code. The student is expected to:**
1. identify different types of DWV fittings and their use;
 2. size a DWV system;
 3. identify and apply different materials used for a DWV system;
 4. determine the slope of a pipe using formulas;
 5. demonstrate an understanding of how to test a DWV system; and
 6. demonstrate an understanding of the different parts and their purpose of a DWV system, such as stacks, vents, traps, building drain, and building sewer.
- O. **The student understands different types of water heaters, water heaters parts, and their proper installation according to plumbing code. The student is expected to:**
1. demonstrate an understanding of storage tank (electric and gas), point of use, on-demand (electric and gas), and solar water heaters;
 2. demonstrate an understanding of parts of the different heaters; and
 3. demonstrate an understanding of the installation of a gas and electric water heater.
- P. **The student develops technology skills. The student is expected to:**
1. Use technology as a tool to research, organize, evaluate, and communicate information;
 2. Use digital technologies (computers, PDAs, media players, GPSs, etc.); communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy;
 3. Demonstrate using current and new technologies specific to the program of study, course, and/or industry; and
 4. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.



Practicum in Construction Technology

1. **General requirements.** This course is recommended for students in Grade 12. The practicum course is a paid or unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Architecture and Construction Career Cluster. Prerequisite: Construction Technology II, Building Maintenance Technology II; Electrical Technology II; Heating, Ventilation, and Air Conditioning (HVAC) and Refrigeration Technology II; or Plumbing Technology I. Students shall be awarded one credit for successful completion of this course.
2. **Introduction.**
 - A. Career and technical education instruction provides students with industry-aligned content, challenging academic standards, and relevant technical knowledge to further their education and succeed in current or emerging professions.
 - B. The Architecture and Construction Career Cluster focuses on designing, planning, managing, building, and maintaining the built environment.
 - C. In Practicum in Construction Technology, students will be challenged with the application of knowledge and skills gained in previous construction-related coursework. In many cases, students will be allowed to work at a job (paid or unpaid) outside of school or be involved in local projects the school has approved for this class.
 - D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which includes paid or unpaid internship, pre-apprenticeship, or apprenticeship experiences relevant to the program of study.
 - E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
3. **Knowledge and skills.**
 - A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
 1. explain the role of an employee in the construction industry;
 2. demonstrate critical-thinking skills;
 3. demonstrate the ability to solve problems using critical-thinking skills;
 4. demonstrate knowledge of basic computer systems;
 5. explain common uses for computers in the construction industry;
 6. demonstrate effective relationship skills; and
 7. recognize workplace issues such as sexual harassment, stress, and substance abuse.
 - B. **The student develops a management plan for a project or an activity. The student is expected to:**
 1. identify and describe the steps required to complete a project using project management processes, including initiating, planning, executing, monitoring and controlling, and closing a project;
 2. determine and acquire the resources needed to complete a project; and
 3. develop a project schedule.



- C. **The student applies the appropriate codes, laws, standards, or regulations related to a research and development project. The student is expected to:**
1. identify areas where codes, laws, standards, or regulations may be required;
 2. locate the appropriate codes, laws, standards, or regulations; and
 3. interpret and comply with the appropriate codes, laws, standards, or regulations.
- D. **The student describes the expectations for each project using a flowchart. The student is expected to:**
1. use an assessment strategy to determine the task's needs;
 2. describe why each task needs to be in the order it has been assigned;
 3. assess the time frame for each task; and
 4. plot a completed project flowchart expectation.
- E. **The student solves problems, thinks critically, and makes decisions related to research, design, and development. The student is expected to:**
1. develop or improve the project by following a problem-solving strategy;
 2. apply critical-thinking strategies to the analysis and evaluation of proposed technological solutions; and
 3. apply decision-making techniques to the selection of technological solutions.
- F. **The student describes the costs associated with the project. The student is expected to:**
1. develop a bill of materials list for the complete project;
 2. develop a budget, including a cost list, for the complete project; and
 3. determine the most effective way to minimize project costs.
- G. **The student applies communication, mathematics, and science knowledge and skills to the construction activities. The student is expected to:**
1. write technical reports;
 2. deliver technical presentations to the instructor;
 3. identify and describe the mathematical concepts used in projects; and
 4. identify and describe the scientific concepts used in projects.
- H. **The student uses advanced tools, materials, processes, and procedures in the construction project. The student is expected to:**
1. determine and use the appropriate technology needed to solve a problem or complete a task;
 2. evaluate the use of technology in a given situation; and
 3. describe the factors that influence the use of technology in a variety of situations.
- I. **The student develops technology skills. The student is expected to:**
1. Use technology as a tool to research, organize, evaluate, and communicate information;
 2. Use digital technologies (computers, PDAs, media players, GPSs, etc.); communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy;
 3. Demonstrate using current and new technologies specific to the program of study, course, and/or industry; and
 4. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.