

Wallenpaupack Area School District Planned Course Curriculum Guide

Career and Technical Education

Building Construction Level 2

Course Description: Residential Wiring

This course introduces students to the repair, maintenance, and installation of residential electrical systems and equipment, including switches, receptacles, lighting, and transformers. Students learn to locate and diagnose electrical malfunctions using standard test instruments such as voltmeters, continuity testers, and test lamps, and to correct problems by replacing defective components or wiring with appropriate hand and power tools. Instruction emphasizes electrical safety procedures, including basic lockout/tagout concepts, safe use of ladders and cords, and the consistent use of personal protective equipment (PPE) such as safety glasses, insulated gloves, hearing protection, and appropriate footwear. Learners read and interpret basic blueprints, wiring diagrams, and building plans to plan layouts, route cable, and install circuits in compliance with the National Electrical Code (NEC) and local building codes. Students install and adjust fixtures and devices, inspect circuits and wiring for proper shielding and grounding, and complete all work in accordance with applicable codes and safety regulations while being introduced to industry expectations and licensing requirements.

Residential Plumbing

This course covers the assembly, installation, and repair of piping, fittings, and fixtures for water supply and drainage systems in accordance with specifications and plumbing codes. Students learn to read and interpret building plans, plumbing drawings, and pipe system sketches to determine required materials, tools, and the sequence of installations. Instruction includes inspecting structures to identify obstructions, laying out and marking locations for pipes, connections, and passage holes, and cutting openings in walls and floors using appropriate hand and power tools. Learners cut and thread pipe; assemble and install valves, fittings, and piping made from metallic and nonmetallic materials; and join piping using approved mechanical and joining methods while following OSHA-aligned safety practices and using PPE such as safety glasses, gloves, hearing protection, and proper footwear and clothing. The course also addresses installation, repair, and maintenance of common fixtures such as sinks, toilets, bathtubs, water

heaters, disposals, and dishwashers, with a strong emphasis on code-compliant work, understanding relevant plumbing codes and regulations, and maintaining safe, organized work areas.

Initial Creation Date (if applicable) and Revision Dates:

9/2025

Wallenpaupack Area School District Curriculum

COURSE: Building Trades Level 2

GRADE/S:11

UNIT: Residential Wiring Introduction

TIMEFRAME:

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

CC.1.2.11–12.F Evaluate how words and phrases shape meaning and tone in texts.

CC.1.2.11–12.J Acquire and use accurately general academic and domain specific words and phrases, sufficient for reading, writing, speaking, and listening at the college- and career-readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Math:

CC.2.4.HS.B.1 Summarize, represent, and interpret data on a single count or measurement variable.

CC.2.4.HS.B.5 Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

Career Education:

13.2.11.D Analyze, revise, and apply an individualized career portfolio to chosen career path.

13.3.11.A Evaluate personal attitudes and work habits that support career retention and advancement.

Science:

3.1.12. A. Apply concepts of systems, subsystems, feedback, and control to solve complex technological problems.

Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems.

Apply systems analysis to predict results.

Analyze and describe the function, interaction and relationship among subsystems and the system itself.

Compare and contrast several systems that could be applied to solve a single problem.

Evaluate the causes of a system's inefficiency.

3.2.12. A. Evaluate the nature of scientific and technological knowledge.

Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Understand the basics of residential electrical systems and components.
- Learn about wiring materials, tools, and safety practices.
- Gain hands-on experience in installing and troubleshooting residential wiring.
- Develop knowledge of electrical codes and regulations.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Orientation**
 - Shop Layout
 - Shop Rules
 - Shop Requirements
 - Course Goals
 - Grading and Attendance
- **Electrical Fundamentals**
 - Overview of electricity (voltage, current, resistance)
 - Understanding circuits: series vs. parallel
 - Introduction to residential electrical systems and components (service panel, breakers, outlets, switches)
- **Safety Practices**
 - Importance of electrical safety
 - Personal protective equipment (PPE) for electrical work
 - Overview of lockout/tagout procedures and working with live circuits
- **Wiring Materials**
 - Types of wiring (NM cable, conduit, THHN wire)
 - Understanding wire gauges and insulation ratings
 - Overview of connectors, junction boxes, and other accessories
- **Tools for Electrical Work**
 - Essential tools for residential wiring (wire strippers, multimeter, circuit tester, drills)

- Safe handling and maintenance of tools
- Hands-on practice: Using basic electrical tools

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Participation and attendance
- Practical assessments and demonstrations
- Final quiz or project showcasing introduction to wiring skills

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Orientation and Shop Layout

Design a digital 3D model of a modern electrical lab layout using CAD or SketchUp, optimizing for workflow, safety zones, and tool accessibility.

Analyze OSHA and NFPA shop-layout standards, then present a redesign proposal to improve real-world safety efficiency.

Shop Rules and Course Goals

Lead a peer workshop to develop a “Safety and Efficiency Charter,” comparing OSHA 1910.332–335 and local safety codes.

Evaluate historical electrical code evolution and create a visual timeline linking technological advances (e.g., smart panels, EV systems).

Electrical Fundamentals

Build a fully functional AC/DC trainer circuit to demonstrate voltage drop and load balancing using simulation tools like Multisim or iConnect.

Design and document an experimental project comparing conductive materials and resistivity—a lab-based prototype aligned to Ohm’s Law.

Develop and present voltage-current relationship graphs comparing real versus simulated lab data.

Safety Practices

Conduct a formal arc-flash risk assessment following NFPA 70E standards.

Create an interactive augmented-reality (AR) safety hazard map of the electrical shop or a simulated jobsite.

Author a mini safety manual referencing OSHA §1910.333 and NFPA 70B, including PPE voltage ratings, labeling, and lockout/tagout schema.

Wiring Materials

Research sustainability trends in wiring (low-VOC insulation, recycled copper, smart cable), then propose an eco-efficient wiring solution.

Build a comparative matrix of NM-B, THHN, and SE cables evaluating ampacity, insulation rating, and NEC compliance Article 310.

Conduct testing on wire insulation performance under simulated temperature and load conditions.

Tools for Electrical Work

Develop a multimeter calibration standard and prototype a preventive maintenance schedule for lab tools.

Create a video tutorial series demonstrating advanced diagnostic tools (clamp meters, megohmmeters, oscilloscopes).

Present a professional-grade tool evaluation comparing manufacturer specifications for precision, safety, and ergonomics.

Integration Project: Residential Circuit Systems

Plan a full residential wiring simulation (service panel to outlet) integrating 120V and 240V circuits using NEC Articles 210, 220, and 230.

Include smart home integration components (lighting control, surge panels, or energy-monitor modules).

Conduct a self-led inspection audit ensuring full NEC compliance with documentation and load calculations.

Leadership and Innovation Extensions

Participate in an applied NFPA 70E Qualified Person simulation with case analysis of electrical workplace incidents.

Mentor peers through problem-solving scenarios involving code interpretation or system diagnostics.

Submit a capstone proposal redesigning a residential wiring system for energy efficiency and occupant safety, supported by data modeling.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Handouts on wiring materials, safety practices, and code references
- Online resources (videos, articles, interactive guides)
- Suggested reading materials on residential wiring and electrical codes

KEY VOCABULARY:

orientation, introduction, overview, expectations, shop layout, workflow, equipment zones, material storage, safety stations, ventilation, shop rules, conduct, discipline, compliance, responsibility, respect, punctuality, shop requirements, uniform, PPE, attendance, cleanliness, housekeeping, course goals, learning objectives, skill development, technical proficiency, craftsmanship, grading, evaluation, participation, performance, attendance policy, practical exams, theory tests, electrical fundamentals, electricity, voltage, current, resistance, Ohm's Law, circuit, power, continuity, conductivity, insulation, series circuit, parallel circuit, short circuit, load, current flow, resistance, residential system, service panel, meter, breaker, branch circuit, outlet, switch, fuse, grounding, conductor, service entrance, disconnect, safety practices, electrical hazards, shock, arc flash, PPE, insulating gloves, safety glasses, dielectric boots, lockout, tagout, live circuit, insulation tester, wiring materials, NM cable, conduit, THHN wire, gauge, ampacity, insulation rating, junction box, connector, coupler, grommet, fastening, tools, wire stripper, multimeter, circuit tester, drill, fish tape, voltage detector, crimper, pliers, screwdriver, maintenance, calibration, storage, tool safety, hands-on practice, wiring demo, troubleshooting, circuit assembly, measurement, safety verification.

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|--|-------------------|
| Wallenpaupack Area School District Curriculum | |
| COURSE: Building Trades | GRADE/S:11 |
| UNIT: Residential Wiring Safety | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:
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ELA:

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UNIT OBJECTIVES (SWBATS):

- Understand the principles of safety in electrical work.
- Identify potential hazards associated with residential wiring.
- Learn safe practices and procedures for installation and troubleshooting.
- Develop an awareness of relevant codes and regulations regarding electrical safety.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- Electrical Fundamentals and Safety Overview
 - Overview of electrical concepts (voltage, current, resistance)
 - Understanding electrical hazards (shock, fire, arc flash)
 - Importance of safety in residential wiring
- Personal Protective Equipment (PPE)
 - Overview of PPE for electrical work (gloves, goggles, hard hats)
 - Proper use and maintenance of PPE
 - Creating a personal safety checklist
- Lockout/Tagout Procedures
 - Importance of lockout/tagout in electrical safety
 - Steps for implementing lockout/tagout procedures
 - Hands-on practice: Simulating lockout/tagout scenarios
- Working with Live Circuits
 - Understanding the risks of working with live circuits
 - Best practices for de-energizing circuits before working
 - Techniques for safe troubleshooting and testing
- Safe Use of Electrical Tools
 - Overview of common electrical tools (wire strippers, multimeters, drills)
 - Safe handling and maintenance of electrical tools
 - Hands-on practice: Safe use of electrical tools
- Ladder and Fall Protection
 - Safety practices for using ladders when working at heights
 - Understanding fall protection measures
 - Hands-on practice: Proper ladder setup and use
- Electrical Codes and Safety Standards
 - Overview of the National Electrical Code (NEC) and local regulations
 - Importance of compliance in ensuring safety
 - Common code violations and how to avoid them
- Emergency Response and Course Review
 - Emergency procedures for electrical incidents (shock, fire)
 - First aid basics for electrical injuries
 - Course review and practical assessment: Safety demonstration

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- **Participation and attendance**
- **Practical assessments and demonstrations**
- **Final quiz or project showcasing knowledge of safety practices in residential wiring**
- **Shop Assessment**
 - Objective
 - Subjective
 - Written Tests
 - Skill Demonstration Tests

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Electrical Fundamentals

Design and Simulate Electrical Networks

Create a 3D circuit model using AutoCAD Electrical or TinkerCAD to analyze voltage-drop and phase imbalance across loads.

AC/DC Diagnostic Comparison

Conduct an experimental study measuring waveform distortion and power factor differences between AC and DC circuits using an oscilloscope.

Quantitative Analysis Challenge

Lead a lab applying Ohm's Law and Kirchhoff's Laws in multi-loop circuits, using multimeters and simulation data to produce performance graphs.

Understanding Electrical Hazards

Arc Flash Risk Simulation (NFPA 70E)

Use arc flash calculation software (e.g., EasyPower) to determine hazard boundaries and PPE categories for real jobsite scenarios.

Failure Chain Case Analysis

Analyze accident investigation reports, perform root cause analysis, and recommend controls aligning with OSHA 1910 Subpart S.

Thermal Imaging Diagnostics

Use an infrared thermal camera to detect overheating connections and create a technical report interpreting thermal data.

Personal Protective Equipment (PPE)

PPE Voltage Stress Testing

Test various insulating gloves and sleeves under controlled voltage to document dielectric breakdown thresholds.

Digital PPE Inspection System

Build a digital PPE checklist app prototype (in Excel, Notion, or mobile app builder) to track test dates and inspection cycles.

Comparative Field Study

Evaluate differences in PPE standards between NFPA 70E and IEC international regulations.

Lockout/Tagout Procedures

LOTO Implementation Audit

Conduct a complete lockout/tagout procedure audit on simulated lab panels following NFPA 70E Article 120.

Energy Control Mapping

Map all isolation points, transfer switches, and disconnects in a live-lab mock-up electrical system.

Scenario-Based Simulation

Lead peers in a timed hands-on emergency shutdown exercise for multiple circuit energy sources.

Working with Live Circuits

Live Circuit Diagnostics Challenge

Under supervision, perform instrument-based troubleshooting on an energized testing bench and record live current fluctuation data.

Energized Work Permit Creation

Design an official energized work permit proposal using NFPA 70E Article 130.

Digital Twin Safety Analysis

Model a live electrical workspace in digital twin software, defining approach boundaries and safe work zones.

Safe Use of Electrical Tools

Calibration Lab Project

Set up a calibration and maintenance tracking program for multimeters and voltage detectors.

Precision Instrument Analysis

Compare manufacturer accuracy ratings across digital multimeters and design a technical evaluation spreadsheet.

Tool Ergonomics Study

Conduct an ergonomic evaluation of repetitive tool tasks and recommend design improvements.

Ladder and Fall Protection

Fall-Risk Data Modeling

Model fall distance and impact absorption for different harness configurations using physics simulation tools.

Job Hazard Analysis (JHA)

Compile a JHA template focusing on combined electrical and fall hazards.

Peer Teaching Drill

Lead an interactive demonstration where advanced students train peers in ladder stability using OSHA 1926.1053 standards.

Electrical Codes and Safety Standards

Code Interpretation Workshop

Write a short technical paper decoding sections of NEC Articles 210 (Branch Circuits) and 250 (Grounding).

Compliance Reporting Exercise

Audit a sample residential lab layout for code violations, document non-compliance findings, and recommend NEC-corrective actions.

NEC Cross-National Study

Research differences between the NEC (U.S.) and CEC (Canadian) electrical codes, focusing on grounding and bonding practices.

Emergency Response

Incident Energy Management Proposal

Create a PowerPoint or digital report summarizing methods to prevent, respond to, and mitigate electrical incidents using NFPA 70E Emergency Plans.

First-Responder Protocol Drill

Lead a peer simulation of electrical rescue CPR and shock management compliant with ANSI Z358.

Safety System Design Project

Design an electrical lab safety-monitoring system using sensors (smoke, temperature, leakage detection).

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Handouts on electrical safety guidelines, PPE, and code references
- Online resources (videos, articles, interactive quizzes)
- Suggested reading materials on electrical safety and best practices

KEY VOCABULARY:

voltage, current, resistance, Ohm’s Law, circuit, conductor, insulator, grounding, bonding, continuity, power, watt, ampere, volt, ohm, energy, electrical hazard, shock, electrocution, arc flash, fire, overcurrent, short circuit, open circuit, GFCI, AFCI, circuit breaker, fuse, overload, PPE, insulated gloves, hard hat, face shield, dielectric boots, lockout, tagout, de-energize, isolation, verification, live circuit, test instrument, multimeter, continuity tester, voltage detector, wiring, conduit, junction box, outlet, switch, breaker panel, safety inspection, code compliance, NEC, NFPA 70E, OSHA, electrical safety boundaries, incident energy, arc flash boundary, safety checklist, emergency response, CPR, first aid, extinguishers, ladder, fall protection, harness, anchorage, stability, clearance, training, hazard assessment, safe work practices, preventive maintenance, electrical permit, inspection log.

| Wallenpaupack Area School District Curriculum | |
|--|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Wiring Fundamentals, 120 volts, 240 volts | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

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UNIT OBJECTIVES (SWBATS):

- Understand the fundamentals of electrical theory related to residential wiring.
- Identify and safely work with various electrical devices and circuits.
- Design and install both 120V and 240V circuits.
- Apply local electrical codes and safety standards.
- Develop troubleshooting skills for common electrical issues.

- Introduction to Electrical Theory
 - Basics of electricity (voltage, current, resistance)
 - Ohm's Law and power calculations

- Overview of AC vs. DC
- Electrical Concepts
 - Basics of electricity (voltage, current, resistance)
 - Ohm's Law and power calculations
 - Overview of AC vs. DC
- Safety Practices and Electrical Codes
 - Personal protective equipment (PPE)
 - National Electrical Code (NEC) overview
 - Importance of grounding and bonding
- Tools and Materials for Wiring
 - Introduction to wiring tools (multimeter, wire strippers, etc.)
 - Types of wiring (Romex, conduit, etc.)
- Understanding electrical boxes, breakers, and devices
 - 120V Residential Circuits
 - Circuit components (outlets, switches, fixtures)
 - Wiring configurations for 120V circuits
 - Load calculations and circuit sizing
 - Wiring standard outlets and switches
 - Installing circuit breakers and panels
 - Conducting safety checks for code compliance
- Series vs. parallel circuits.
- Introduction to smart home technology and energy-efficient practices.
- Integration of GFCI and AFCI devices for safety.
- Installing 120V Circuits
 - Hands-on practice: wiring outlets and switches
 - Circuit breaker installation and panel considerations
 - Safety checks and code compliance
- Introduction to 240V Circuits
 - Differences between 120V and 240V circuits
 - Common applications for 240V (e.g., dryers, stoves)
 - Wiring techniques for 240V circuits
 - Differences between 120V and 240V systems
 - Wiring configurations for 240V circuits
- Installing 240V Circuits
 - Hands-on practice: wiring 240V devices
 - Understanding double-pole breakers
 - Load calculations for 240V circuits
 - Wiring 240V outlets for specific appliances
 - Understanding and installing double-pole breakers
 - Load calculations for 240V circuits
- Circuit Troubleshooting Techniques
 - Common electrical problems and solutions
 - Using a multimeter for diagnostics
 - Safety protocols while troubleshooting
- Advanced Wiring Techniques
 - Series vs. parallel circuits

- Smart home technology integration
- Energy-efficient practices in wiring
- Project Planning and Design
 - Designing a simple residential wiring plan
 - Understanding blueprints and electrical schematics
 - Permitting and inspection process

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Class Participation
- Class Attendance
- Shop Assessment
- Objective
- Subjective
- Written Tests
- Skill Demonstration Tests
- Written assessment covering theory and codes.
- Practical assessment demonstrating wiring skills.
- Quizzes and tests on theoretical knowledge and code compliance
- Practical assessments based on hands-on projects
- Final capstone project evaluation

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Electrical Fundamentals and Concepts

Dynamic Circuit Modeling:

Use advanced CAD or simulation software (Autodesk Electrical, Multisim, or MATLAB Simulink) to design and simulate complex circuits, then validate Ohm's and Kirchhoff's Laws with data analytics.

Power Efficiency Challenge:

Students design two circuits (AC vs. DC) and compare energy efficiency, waveform behavior, and heat dissipation using oscilloscopes and thermocouples.

Renewable Power Application:

Create a scaled microgrid combining solar, battery, and load circuits to demonstrate real-world power flow management.

Safety Practices and Electrical Codes

NFPA 70E Hazard Audit:

Conduct a full electrical safety audit for a mock residential lab setup—including arc flash boundary calculation and PPE category determination.

Grounding System Design:

Engineer a custom grounding and bonding blueprint meeting NEC Article 250 specifications and model it using CAD tools.

Code-Based Engineering Report:

Write a comparative analysis paper on NEC vs. IEC codes for home installations focusing on fault-current management and conductor sizing.

Advanced Wiring Tools and Materials

Conductor Performance Study:

Test real conductors (THHN, Romex, SE cable) under variable load to chart resistance and temperature rise. Analyze results in Excel or Python plots.

Digital Instrument Calibration:

Develop a calibration plan for test tools (RMS multimeters, clamp meters) referencing ANSI/IEC standards and verification methods.

Material Science Mini-Project:

Research and present on polymer technology innovations for cable insulation and sustainable wiring systems.

120V and 240V Circuit Systems

Smart Circuit Simulation:

Create programmable residential circuits with microcontrollers (Arduino, Raspberry Pi) that control lighting and outlets using sensors or voice activation.

Load Balancing Analysis:

Perform live load-calculation tasks using spreadsheet models for 120V/240V supply to ensure balanced distribution across multi-wire branch circuits.

NEC Compliance Inspection:

Conduct a self-directed inspection of installed circuits to identify and document code-compliance issues, submitting professional reports using NEC Articles 210, 220, and 240.

Circuit Troubleshooting

Live Diagnostics Case Study:

Analyze malfunctioning circuits to identify insulation faults, loose connections, or grounding issues using infrared inspection and continuity testing.

Signal Analysis Task:

Use an oscilloscope to visualize waveform distortion and noise, documenting findings related to DC offset or AC harmonics.

Failure Mode Investigation:

Conduct a Failure Mode and Effects Analysis (FMEA) of electrical system breakdown causes, suggesting design refinements.

Advanced Topics and Project Design

Residential Electrical Blueprint Project:

Design a complete NEC-compliant house electrical diagram integrating 120V and 240V circuits, GFCI/AFCI protection, grounding, and renewable inputs.

Smart Energy Integration:

Build a digital home automation prototype (via IoT systems) managing power use and energy metering in real time.

Professional Code Review Presentation:

Lead a team-based seminar explaining NEC Articles 90–250 with real-world examples and compliance implications for builders and inspectors.

Enrichment Extensions

NEC Living Case Study:

Analyze a real residential wiring design against NEC recent updates (2023/2025 edition) and present corrective recommendations.

Sustainability Challenge:

Engineer a wiring system optimized for minimal energy loss and maximum lifespan using recyclable or low-impact materials.

Electrical Theory Symposium:

Host a student-led symposium presenting quantitative research on electric power systems, safety design trends, and smart grid integration.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Textbook on residential wiring
- National Electrical Code (NEC) guidelines
- Online resources and instructional videos

KEY VOCABULARY:

electricity, voltage, current, resistance, Ohm’s Law, power, watts, joules, amperes, volts, ohms, conductors, insulators, circuit, energy, electric field, magnetic field, DC, direct current, AC, alternating current, frequency, phase, waveform, sine wave, polarity, current flow, potential difference, resistance network, series circuit, parallel circuit, $V=IR$, $P=VI$, load, source, open circuit, short circuit, electron flow, charge, continuity, multimeter, ammeter, voltmeter, ohmmeter, grounding, bonding, PPE, insulated gloves, safety glasses, dielectric tools, National Electrical Code, NEC, NFPA 70, code compliance, conductor, wiring, wire gauge, conduit, junction box, circuit breaker, fuse, outlet, switch, 120V circuit, 240V circuit, double-pole breaker, GFCI, AFCI, energy efficiency, smart home, troubleshooting, diagnostics, schematic, blueprint, circuit design, safety practices, electrical hazard, arc flash, shock prevention.

| Wallenpaupack Area School District Curriculum | |
|--|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Wiring Service Entrance Panel | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

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UNIT OBJECTIVES (SWBATS):

- Understand the components and functions of a service entrance panel.
- Learn installation techniques for service entrance panels.
- Familiarize yourself with relevant electrical codes and safety practices.
- Develop troubleshooting and maintenance skills for service entrance panels.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- Introduction to Service Entrance Panels
 - Purpose and importance of the service entrance panel.
 - Overview of electrical systems in residential wiring.
 - Components of a service entrance panel (main breaker, bus bars, grounding).
- **Electrical Codes and Safety Standards**

- Overview of the National Electrical Code (NEC) as it pertains to service entrance panels.
- Understanding local regulations and code compliance.
- Safety practices when working with electrical systems.
- **Tools and Materials**
 - Essential tools for panel installation (screwdrivers, multimeters, etc.).
 - Types of service entrance panels (main breaker vs. main lug).
 - Understanding conductors, cables, and connectors used in installations.
- **Service Entrance Panel Installation**
 - Site selection and preparation for panel installation.
 - Mounting the service entrance panel and making connections.
 - Installing grounding systems and bonding conductors.
- **Wiring the Service Entrance Panel**
 - Connecting the service drop to the panel.
 - Properly wiring branch circuits to the panel.
 - Understanding load calculations and panel capacity.
- **Troubleshooting Service Entrance Panels**
 - Common issues related to service entrance panels.
 - Diagnostic techniques for troubleshooting panel problems.
 - Use of a multimeter and other tools for testing.
- **Maintenance and Inspection**
 - Regular maintenance practices for service entrance panels.
 - Identifying signs of wear, damage, or overheating.
 - Understanding the inspection process for service entrance panels.

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Students develop a comprehensive plan for installing a service entrance panel in a hypothetical home.
- Hands-on practice of installing and wiring a service entrance panel.
- Written assessment covering theory, codes, and practical skills.
- Quizzes and tests on theoretical knowledge and codes.
- Practical assessments based on installation and troubleshooting tasks.
- Final project evaluation and presentation.

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Code-Based Design & Engineering

NEC Article 230 Application: Design and present a custom residential service entrance panel layout using current NEC standards (e.g., available fault current calculations, clearance, labeling, and grounding requirements).

Local Code Mapping: Compare NEC requirements with local codes/amendments. Prepare a chart showing conflicts and solutions for code compliance in real installations.

Digital & Analytical Project Work

3D Panel Modeling: Use CAD or online drafting software to build a detailed 3D service entrance panel, including bus bars, main breaker, grounding, and space for future expansion. Evaluate mounting location and clearances for safety and access.

Load Capacity Modeling: Create a spreadsheet or Python script to calculate load capacity, available fault current, and panel ratings for complex residential loads (EV charging, large appliances, or solar inverters).

Professional Troubleshooting & Diagnostics

Simulated Panel Faults: Use or construct a training panel with intentional faults (loose connections, hot/neutral reverse, overheating, bus bar oxidation). Document troubleshooting steps using systematic approaches, including multimeter, insulation resistance tester, and thermal imaging.

Failure Chain Analysis: Conduct root cause analysis for historical panel failure or real-life incident reports. Present recommendations for improved installation, inspection, or maintenance.

Inspection & Compliance Leadership

Inspection Process Audit: Develop a checklist for rough-in and final panel inspections based on NEC Article 110 and local AHJ protocols. Lead a peer mock-inspection and present improvement suggestions.

Panel Upgrade Proposal: Evaluate the need for upgrading service entrance panels in an aging home (e.g., adding surge protection, Arc Fault or replacing main breakers). Calculate impact on panel capacity and safety.

Innovation and Sustainability Challenge

Smart Panel Integration: Research and design a concept service entrance panel integrating smart metering, automated main disconnects, and remote fault notifications. Outline benefits for modern households and code compliance.

Eco-Efficient Materials Report: Investigate alternative cables, connectors, and enclosures (e.g., corrosion-resistant, low-carbon manufacture) and propose best options for sustainable installations.

Advanced Hands-on Simulations

Full Install Simulation: Plan and set up a simulated service entrance panel install, following all safety and code procedures (site selection, mounting, grounding, wiring branch circuits). Document all steps and conduct self-led inspections.

Maintenance Planning: Develop a maintenance schedule for periodic inspections, tightening, IR scanning, and cleaning. Create documentation procedures for identifying wear, oxidation, and overheating.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Textbook on residential electrical systems.
- National Electrical Code (NEC) guidelines.
- Online resources and instructional videos for visual learning.

KEY VOCABULARY: service entrance, electrical service, main panel, panelboard, load center, distribution panel, main breaker, disconnect, service conductors, service drop, service lateral, grounding electrode, bonding jumper, neutral bar, ground bar, bus bar, meter base, conduit, enclosure, lug, main lug panel, overcurrent protection, breaker, fuse, NEC Article 230, NEC 408, NEC 250, NFPA 70, working space, clearance, accessibility, mounting height, dedicated space, labeling, panel capacity, ampere rating, circuit rating, feeder, branch circuit, load calculation, conductor sizing, copper, aluminum, SE cable, SER, SEU, THHN, RMC, IMC, PVC conduit, raceway, breaker slot, GFCI, AFCI, surge protection, grounding system, bonding connection, main bonding jumper, fault current, overvoltage protection, panel maintenance, inspection, overheating, corrosion, oxidation, tightening torque, electrical lug connections,

troubleshooting, continuity testing, insulation resistance, multimeter, voltage tester, torque wrench, PPE, insulated tools, safety glasses, lockout, tagout, de-energized equipment, panel labeling, code compliance, local electrical code, utility interface, load balancing, expansion capacity, service disconnect location, emergency disconnect, bonding terminal, bus isolation, neutral-to-ground separation, moisture protection, wire fill, conductor bend radius, arc flash safety, maintenance schedule, inspection checklist, fault isolation.

| Wallenpaupack Area School District Curriculum | |
|---|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Wiring Conduit | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

CC.1.2.11–12.F Evaluate how words and phrases shape meaning and tone in texts.

CC.1.2.11–12.J Acquire and use accurately general academic and domain specific words and phrases, sufficient for reading, writing, speaking, and listening at the college- and career-readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Math:

CC.2.4.HS.B.1 Summarize, represent, and interpret data on a single count or measurement variable.

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Career Education:

13.2.11.D Analyze, revise, and apply an individualized career portfolio to chosen career path.

13.3.11.A Evaluate personal attitudes and work habits that support career retention and advancement.

Science:

3.1.12. A. Apply concepts of systems, subsystems, feedback, and control to solve complex technological problems.

Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems.

Apply systems analysis to predict results.

Analyze and describe the function, interaction and relationship among subsystems and the system itself.

Compare and contrast several systems that could be applied to solve a single problem.

Evaluate the causes of a system's inefficiency.

3.2.12. A. Evaluate the nature of scientific and technological knowledge.

Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Differentiate between thin-wall (EMT) and rigid conduits and their applications in residential wiring.
- Demonstrate effective bending techniques for both types of conduits.
- Conduct safe installation practices in accordance with local electrical codes.
- Read and interpret electrical blueprints and schematics for conduit and wiring layout.
- Perform complete conduit installations, including wiring and termination.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

Introduction to Conduits and Safety

- Conduit
 - Overview of conduit types: EMT vs. rigid
 - Applications in residential wiring
 - Safety protocols and regulations
 - Discussion on safety practices
 - Introduction to tools and equipment
- Basic Bending Techniques for Thin-Wall Conduit (EMT)
 - Bending terminology and measuring techniques
 - Basic bends: 90°, 45°, and simple bends
 - Hands-on practice: students create basic bends with EMT
- Advanced Bending Techniques for EMT and Introduction to Rigid Conduit
 - Compound bends and offsets for EMT
 - Introduction to rigid conduit bending techniques
 - Hands-on practice: students perform advanced bends in EMT and begin rigid conduit
- Bending and Installation of Rigid Conduit
 - Techniques specific to bending rigid conduit
 - Mounting and securing rigid conduit installations
 - Hands-on practice with rigid conduit bending and installation techniques
- Blueprint Reading and Planning Conduit Runs
 - Reading blueprints and electrical schematics
 - Planning conduit runs and wiring layout based on plans

- Group exercises on interpreting blueprints
- Practical planning session for upcoming projects
- Conduit Installation Best Practices
 - Techniques for securing conduits
 - Joining different conduit types
 - Compliance with local codes
 - Practical installation exercises with both EMT and rigid conduit
- Wiring Techniques and Safety
 - Overview of residential wiring techniques
 - Wire types, gauge selection, and application
 - Safety considerations for electrical wiring
 - Hands-on practice: students wire outlets and switches
- Integrating Conduit and Wiring Systems
 - Best practices for running wire through conduits
 - Termination techniques for conduits and wiring
 - Hands-on practice: students install wiring within conduits and perform terminations

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Complete conduit installation project, including bending, installation, and wiring
 - Students complete a project incorporating EMT and rigid conduits.
- Practical test on bending, installation, and wiring techniques, followed by a written test covering terminology, safety, and codes.
- Course wrap-up, feedback session, and discussion on next steps for further learning.
- **Participation:** Active engagement in class discussions and activities.
- **Practical Skills:** Quality of bending, installation, and wiring in hands-on exercises.
- **Assessment Results:** Scores on practical and written tests.

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Conduit Types and Applications

Comparative Research Project: Investigate and present a detailed analysis comparing EMT, rigid conduit, and other types (PVC, IMC), focusing on material properties, corrosion resistance, bending capabilities, and applicable residential scenarios.

Field Application Simulation: Design conduit selection for a residential wiring plan, justifying material choices for indoor vs. outdoor, corrosive environments, or exposed installations.

Safety Protocols and Regulations

Interactive Safety Workshop: Lead a risk assessment exercise simulating real hazards in conduit installation sites integrating PPE requirements, lockout/tagout essentials, and safety code compliance (OSHA, NEC Article 358, 344).

Safety Manual Creation: Develop a digital or printed safety manual specifically for conduit installation tasks, including PPE, tool handling, and emergency procedures.

Basic and Advanced Bending Techniques

Precision Bending Challenge: Using EMT benders, students calculate and execute complex bends (90°, 45°, offsets, back-to-back bends) with exact measurements incorporating take-up and gain calculations; documented with photos and stepwise explanation.

3-Point Saddle Project: Master creating 3-point saddle bends to maneuver conduits around obstacles; students film their process and analyze accuracy versus blueprint requirements.

Rigid Conduit Advanced Application: Practice hydraulic or electric bender use on rigid conduits with emphasis on bending radius maintenance, axis rotation control, and damage prevention.

Blueprint Reading and Planning

Blueprint Interpretation Workshop: Conduct group exercises decoding electrical schematic symbols, conduit routing, and load annotations on residential blueprints.

Conduit Planning Exercise: Plan and draw conduit runs on provided blueprints incorporating code-mandated bend radii, support intervals, and junction box placement; peer review for code compliance.

Installation Best Practices

Hands-On Installation Simulation: Perform realistic conduit installation including cutting, deburring, bending, joining various conduit types and securing with proper supports; execute following NEC clearance and conductor fill rules.

Code Compliance Audit: Evaluate installed conduit setups for adherence to NEC and local amendments through inspection checklists; report common violations and corrective actions.

Wiring Techniques and Safety

Wire Pulling Techniques Lab: Simulate wire pulling through complex conduit runs using fish tape, lubricants, and tension meters; analyze best practices to avoid conductor insulation damage.

Electrical Termination and Connection: Practice standard conduit terminations ensuring proper bends, grounding bushings, and junction box connections for residential wiring.

Integration of Conduit and Wiring Systems

Wiring Installation Project: Complete full wiring installation inside conduit pathways documenting wire gauge selections, insulation ratings, and termination methods.

Comprehensive Safety Assessment: Conduct post-installation walkthrough checking for physical hazards, proper PPE usage, tool condition, and lockout/tagout application during installation.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- National Electrical Code (NEC) handbook
- Wiring and conduit installation manuals

KEY VOCABULARY: conduit, EMT, Electrical Metallic Tubing, RMC, Rigid Metal Conduit, GRC, Galvanized Rigid Conduit, PVC conduit, flexible conduit, intermediate conduit (IMC), conduit body, coupling, connector, compression fitting, set-screw fitting, threaded fitting, conduit bender, sweep, offset, 90° bend, 45° bend, saddle bend, back-to-back bend, hand bender, mechanical bender, hydraulic bender, radius, stub-up, offset measurement, take-up, shrink, gain, alignment, junction box, conduit run, raceway, support strap, strap spacing, strap anchor, conduit hanger, mounting bracket, locknut, bushing, grounding bushing, Bonding, grounding path, equipment grounding conductor (EGC), NEC Article 344, NEC Article 358, electrical code compliance, installation clearance, support intervals, conduit fill, conductor derating, wire pulling, wire lubricant, fish tape, pull box, conduit layout, blueprint reading, electrical plan, conduit routing, wall penetration, floor penetration, offset alignment, structural support, rigid conduit threading, reamer, die, cutting oil, torque wrench, safety practices, PPE, gloves, goggles, safety glasses, dielectric boots, lockout, tagout, energized circuit, conduit installation safety, bending safety, fall protection, blueprint symbols, plan interpretation, conduit material selection, corrosion resistance, environmental exposure,

underground installation, indoor application, outdoor application, residential wiring, load center connection, conduit termination, sealing fittings, bonding jumper, inspection, maintenance, damage prevention, alignment accuracy, conduit expansion fitting, conduit integrity, moisture protection, fire rating, conduit marking, labeling, conduit identification, mechanical protection.

| Wallenpaupack Area School District Curriculum | |
|--|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Plumbing Introduction | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

CC.1.2.11–12.F Evaluate how words and phrases shape meaning and tone in texts.

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Math:

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Career Education:

13.2.11.D Analyze, revise, and apply an individualized career portfolio to chosen career path.

13.3.11.A Evaluate personal attitudes and work habits that support career retention and advancement.

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3.1.12. A. Apply concepts of systems, subsystems, feedback, and control to solve complex technological problems.

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Compare and contrast several systems that could be applied to solve a single problem.

Evaluate the causes of a system's inefficiency.

3.2.12. A. Evaluate the nature of scientific and technological knowledge.

Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Understand the basic principles and components of residential plumbing systems.
- Identify tools and materials used in plumbing.
- Recognize safety practices and codes relevant to plumbing.
- Explore various career paths within the plumbing industry and the necessary qualifications for each.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Plumbing Safety and Codes**
 - Overview of plumbing safety practices
 - Personal Protective Equipment (PPE) in plumbing
 - Introduction to local plumbing codes and regulations
 - Case studies on safety incidents in plumbing
 - Group activity: review and discuss local code requirements
- **Plumbing Systems**
 - Overview of residential plumbing systems
 - Key components: water supply, drainage, and fixtures
 - Basic plumbing terminology
 - Lecture on the anatomy of a plumbing system
 - Group discussion on common plumbing issues in homes
- **Tools and Materials**
 - Essential plumbing tools: hand tools and power tools
 - Common plumbing materials: pipes (PVC, copper, PEX), fittings, and fixtures
 - Proper tool handling and maintenance
 - Hands-on demonstration of tools
 - Tool identification exercise
- **Basic Plumbing Techniques**
 - Introduction to basic plumbing tasks: cutting, joining, and installing pipes
 - Understanding plumbing fixtures and their installation
 - Troubleshooting common plumbing problems
 - Hands-on practice with pipe cutting and joining techniques
 - Installation practice of basic fixtures (e.g., sinks, faucets)
- **Career Opportunities in Plumbing**

- Overview of plumbing careers: plumber, pipefitter, inspector, and more
- Educational pathways and certifications (apprenticeships, trade schools)
- Building a career in plumbing: job search strategies and professional development
- Guest speaker from the plumbing industry
- Career exploration exercise: research and presentation on different plumbing careers

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- **Participation:** Engagement in discussions and activities.
- **Practical Skills:** Quality of work in hands-on exercises.
- **Assessment:** Short quizzes on terminology, safety, and tools.

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Plumbing Safety Practices

Advanced Safety Workshop: Analyze case studies of plumbing accidents to identify root causes and design improved safety protocols integrating PPE selection, hazard assessment, and emergency response planning.

PPE Testing and Evaluation: Conduct experiments testing PPE performance (gloves, goggles, respirators) under simulated jobsite conditions with chemical and mechanical hazards.

Toolbox Talk Leadership: Develop and lead toolbox talks on electrical safety, fall protection, and hazardous materials handling in plumbing contexts.

Codes and Regulations

Local Code Comparison Research: Investigate plumbing code differences across municipalities; create a compliance guide highlighting variances and impacts on installation and safety.

Regulatory Role-Play: Simulate an inspection scenario where students critique plumbing installations against Uniform Plumbing Code (UPC) and local regulations, recommending corrections.

Code Evolution Timeline: Develop an interactive timeline showing key developments in plumbing codes and their safety improvements over time.

Plumbing Systems and Terminology

System Mapping Project: Using real plumbing schematics, map and label component functions, flow directions, and control mechanisms; incorporate life-cycle maintenance schedules.

Terminology Flash Creations: Create visual flashcards with diagrams and terminology explanations to deepen understanding of parts like traps, vents, valves, and service lines.

Common Issue Diagnosis Lab: Develop diagnostic flowcharts for frequent household plumbing problems (clogs, leaks, backflow) combining theory and practical knowledge.

Tools and Materials

Material Performance Testing: Compare durability, corrosion resistance, and flexibility of PVC, copper, and PEX pipes through lab experiments simulating temperature/pressure variations.

Tool Ergonomics Study: Analyze commonly used plumbing tools focusing on injury prevention and efficiency improvements, proposing ergonomic redesigns.

Maintenance Protocol Design: Create stepwise tool maintenance manuals, including calibration, cleaning, and safety inspection protocols aligned with industry standards.

Basic Plumbing Techniques

Precision Joinery Challenge: Master pipe cutting, threading, and joining methods via timed tasks measuring quality and leak resistance.

Fixture Installation Competition: Install various fixtures (sinks, faucets, toilets) to exact specification tolerances, incorporating troubleshooting for fit and flow issues.

Interactive Troubleshooting Simulator: Use virtual or physical simulators presenting plumbing fault scenarios requiring diagnosis and repair strategy formulation.

Career Opportunities and Professional Development

Industry Panel Presentation: Organize guest lectures featuring master plumbers, inspectors, and safety officers discussing career pathways, certifications, and apprenticeship expectations.

Career Research & Presentation: Students research specific plumbing trades (pipefitting, steamfitting), then prepare persuasive presentations on educational requirements, salary prospects, and job outlook.

Skill-Building Portfolio: Encourage students to compile portfolios documenting completed tasks, certifications, safety trainings, and portfolio projects.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Plumbing textbooks and manuals
- Local plumbing codes and regulations
- Plumbing trade association websites
- Video tutorials on basic plumbing techniques

KEY VOCABULARY: plumbing safety, PPE, gloves, goggles, respirator, hard hat, safety boots, hazard assessment, emergency response, safety incident, lockout/tagout, local plumbing codes, code compliance, residential plumbing system, water supply, drainage system, plumbing fixture, water heater, pipe, PVC pipe, copper pipe, PEX pipe, fitting, valve, trap, vent, shut-off valve, ball valve, angle stop, aerator, backflow preventer, anti-siphon valve, check valve, water meter, sump pump, plumbing terminology, pipe cutter, pipe wrench, basin wrench, auger, plunger, threader, soldering torch, pipe joint compound, Teflon tape, pipe fitting, pipe coupling, elbow, tee, pipe flange, solder, joining techniques, pipe threading, pipe glue, pipe insulation, faucet installation, sink installation, toilet installation, pipe leak, clog, backup, water hammer, water pressure, pressure regulator, leak detection, pipe repair, fixture installation, tool maintenance, career paths, plumber, pipefitter, plumbing inspector, apprenticeship, trade school, plumbing certification, professional development, job search strategies, industry guest speaker, career exploration, plumbing trade skills.

Wallenpaupack Area School District Curriculum

COURSE: Building Trades

GRADE/S:

UNIT: Residential Plumbing Safety

TIMEFRAME:

PA COMMON CORE/NATIONAL STANDARDS:

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

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Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Understand the importance of safety in plumbing.
- Identify common hazards in residential plumbing.
- Demonstrate the correct use of personal protective equipment.
- Apply safe practices when using plumbing tools and equipment.
- Respond appropriately to emergencies and accidents.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Introduction to Plumbing Safety**
 - Overview of plumbing safety
 - Importance of safety in residential plumbing
 - Responsibilities of plumbers regarding safety
- **Personal Protective Equipment**

- Types of PPE: gloves, goggles, hard hats, respirators, etc.
- Proper use and maintenance of PPE
- Situational awareness and PPE requirements
- **Hazard Identification**
 - Common hazards in residential plumbing:
 - Chemical exposure (e.g., cleaning agents)
 - Physical hazards (e.g., slips, trips, falls)
 - Electrical hazards
- Risk assessment strategies
- Importance of site assessment before starting work
- **Safe Tool and Equipment Practices**
 - Safe handling and usage of hand and power tools
 - Tool maintenance and inspection procedures
 - Lockout/tagout procedures for power tools
 - Safe lifting techniques and ergonomics
- **Safe Work Practices**
 - Worksite organization and cleanliness
 - Proper installation and repair techniques
 - Safety in confined spaces and working at heights
 - Use of scaffolding and ladders
- **Emergency Procedures**
 - First aid for plumbing-related injuries
 - Emergency response plans and evacuation procedures
 - Reporting incidents and near misses
 - Understanding and using fire extinguishers
- **Review and Practical Application**
 - Case studies of plumbing accidents and safety lessons learned
 - Group discussions on safety scenarios and best practices
 - Practical demonstrations of PPE usage and safe tool handling

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Participation in discussions and practical exercises
- Quizzes on safety knowledge and hazard identification
- Final assessment (written or practical) demonstrating safety competencies

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Plumbing Safety Practices & Responsibilities

Develop a plumbing safety protocols manual incorporating OSHA regulations, PPE use, and hazard mitigation strategies tailored to residential and commercial plumbing sites.

Conduct a risk assessment project analyzing chemical, physical, and electrical hazards on simulated plumbing jobs. Present mitigation plans emphasizing hierarchy of controls and site awareness.

Personal Protective Equipment (PPE)

Lead a PPE efficacy experiment testing material durability and chemical resistance for gloves, goggles, and respirators used in plumbing tasks.

Create a digital PPE checklist tool integrated with inspection schedules and inventory management for plumbing workplaces.

Hazard Identification and Risk Assessment

Participate in a hazard mapping exercise to identify and classify common plumbing safety risks, including slips, falls, chemical exposure, and electrical shock.

Perform case study analyses of real plumbing accident reports, identifying root causes, and proposing safety improvements.

Safe Tool and Equipment Use

Conduct a tool maintenance workshop with hands-on calibration, inspection, and repair of plumbing hand and power tools.

Simulate lockout/tagout procedures for plumbing power tools during maintenance tasks ensuring compliance with OSHA 1910.147 and hazard communication protocols.

Safe Work Practices and Site Organization

Design a plumbing worksite layout plan optimizing tool storage, material handling, and waste disposal to maximize safety and efficiency.

Execute a confined space and elevated work training module including scaffold use, ladder safety, and fall arrest system inspection.

Emergency Procedures and First Aid

Practice first aid drills for common plumbing injuries, including burns, cuts, chemical exposures, and electrical shocks aligned with ANSI and OSHA first responder guidelines.

Develop emergency response plans including evacuation routes, spill containment, and fire extinguisher use specific to plumbing jobsites.

Review and Practical Application

Lead collaborative safety scenario role-plays where students troubleshoot unexpected incidents, applying PPE use, hazard recognition, and emergency protocols.

Create multimedia safety demonstrations showcasing proper PPE donning/doffing, tool handling, and hazard control techniques.

RESOURCES (Technology Based Resources, Text Resources, etc.):

KEY VOCABULARY: plumbing safety, PPE, gloves, goggles, hard hat, respirator, safety boots, chemical exposure, cleaning agents, slips, trips, falls, electrical hazards, confined spaces, hazard assessment, site assessment, risk management, lockout/tagout, tool maintenance, power tools safety, hand tools safety, ergonomics, safe lifting, worksite organization, housekeeping, scaffolding safety, ladder safety, fire extinguisher, first aid, emergency response plan, incident reporting, near miss, plumbing codes, local regulations, OSHA standards, NFPA, safety training, water supply system, drainage system, plumbing fixtures, pipe cutting, pipe joining, soldering, plumbing leaks, clog diagnosis, plumbing tools, pipe wrench, basin wrench, pipe cutter, soldering torch, plumbing fittings, valve types, water heater safety, pipe insulation, fixture installation, job hazard analysis, safety drills, accident case study, PPE inspection, safety signage, personal safety checklist, group safety discussion, practical safety demonstration, plumbing career pathways, plumber certification, apprenticeship, continuing education, industry standards, professional development

| Wallenpaupack Area School District Curriculum | |
|--|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Plumbing | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

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UNIT OBJECTIVES (SWBATS):

- Understand plumbing systems and components in residential settings.
- Develop hands-on skills for installation, maintenance, and repair.
- Learn safety practices and local plumbing codes.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Plumbing Tools Overview**
 - Detailed review of essential plumbing tools
 - Proper use and maintenance of tools
 - Pipe cutters
 - Plumbers' tape
 - Adjustable wrenches
- **Water Supply Systems**
 - Types of water supply systems
 - Overview of piping materials (PVC, copper, PEX)
 - PEX crimping tools
 - Pipe benders
- **Drainage Systems**
 - Understanding drainage systems and traps
 - Installation of sinks and toilets
 - Augers
 - Drain snakes
- **Fixture Installation**
 - Installing faucets and bathtubs
 - Sealing and caulking techniques
 - Basin wrenches
 - Caulking guns
- **Troubleshooting Common Issues**
 - Identifying and fixing leaks and clogs
 - Basic troubleshooting techniques
 - Inspection cameras
 - Pipe inspection tools
- **Water Heaters**
 - Types of water heaters and their maintenance
 - Installation best practices
 - Soldering kits
 - Temperature gauges
- **Advanced Plumbing Techniques**
 - Working with gas lines safely
 - Understanding backflow prevention
 - Gas leak detectors
 - Manifold gauges
- **Plumbing Maintenance**
 - Routine maintenance practices
 - Winterizing plumbing systems
 - Thermometers
 - Water testing kits

- **Local Plumbing Codes**

- Overview of local plumbing codes and regulations
- Understanding the permitting process
- Code reference books

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Hands-on project: Installation of a complete plumbing system in a mock setting
- Comprehensive toolkit from previous weeks
- Review of key concepts
- Practical and written assessments
- Practical skill assessments
- Written quizzes
- Final project evaluation

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Tool Mastery

Conduct an in-depth comparative research project on the metallurgy and manufacturing processes of pipe cutters, wrenches, and PEX crimping tools, emphasizing durability and ergonomic design.

Develop a maintenance log system for plumbing tools incorporating manufacturer specifications, inspection checklists, and preventive care schedules.

Create a professional demonstration video series on proper use and safety precautions for pipe benders, caulking guns, manifold gauges, and soldering kits.

Water Supply and Drainage Systems

Design and model a residential water supply system integrating multiple piping materials (PVC, copper, PEX) with a virtual simulation tool to analyze flow rate, pressure loss, and system efficiency.

Perform a diagnostic analysis of drainage systems and traps using digital inspection cameras and propose innovative clog prevention solutions backed by fluid dynamics principles.

Fixture Installation and Troubleshooting

Lead a project installing complex fixtures (multi-valve tubs, sensor faucets) incorporating sealing and caulking best practices. Document installation with technical drawings and video explanation.

Utilize thermal imaging and pressure test gauges to troubleshoot and resolve advanced leak and clog scenarios in plumbing systems.

Advanced Plumbing Techniques

Develop safety protocols and conduct hands-on training for working with gas lines using manifold gauges and gas leak detectors, aligning with NFPA 54 and OSHA standards.

Create an educational workshop on backflow prevention technologies and their integration into modern residential plumbing.

Plumbing Maintenance and Regulations

Plan and execute seasonal plumbing maintenance routines, including winterizing systems, water testing with digital kits, and equipment calibration.

Research local plumbing codes and develop a compliance guide including step-by-step permitting processes, inspection standards, and code reference navigation strategies.

RESOURCES (Technology Based Resources, Text Resources, etc.):

KEY VOCABULARY:

pipe wrench, basin wrench, adjustable wrench, pipe cutter, plastic pipe cutter, tubing cutter, plumber's torch, thread sealing tape, Teflon tape, pliers, deburring tool, press fitting system, hacksaw, hole saw, mole grips, pipe and tube bender, flashlight, bucket, ratcheting pipe threader, reaming tool, caulking gun, pipe expander, pipe crimper, drain auger, drain snake, inspection camera, water heater wrench, temperature gauge, pipe insulation, soldering kit, pipe joint compound, pitot gauge, manifold gauge, water pressure gauge, leak detection kit, pipe tape measure, safety goggles, gloves, respirator, hard hat, safety boots, tool maintenance, power tool lockout, jobsite PPE, hazard recognition, sanitation tools, tool identification, safe lifting techniques, emergency response equipment, chemical exposure precautions, worksite organization, ladder safety, scaffold safety, confined space safety, fire extinguisher, first aid kit, plumbing codes, local regulations, permit application, code compliance, plumbing fixtures, water supply systems, drainage systems, plumbing installation, troubleshooting leaks, clog removal, fixture installation, pipe joining techniques, copper pipe tools, PEX tools, PVC pipe tools, safety practices, risk assessment strategies, PPE maintenance, incident reporting.

| Wallenpaupack Area School District Curriculum | |
|---|-------------------|
| COURSE: Building Trades | GRADE/S: |
| UNIT: Residential Plumbing Tubing Installation | TIMEFRAME: |

PA COMMON CORE/NATIONAL STANDARDS:

ELA:

CC.1.2.11–12.F Evaluate how words and phrases shape meaning and tone in texts.

CC.1.2.11–12.J Acquire and use accurately general academic and domain specific words and phrases, sufficient for reading, writing, speaking, and listening at the college- and career-readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Math:

CC.2.4.HS.B.1 Summarize, represent, and interpret data on a single count or measurement variable.

CC.2.4.HS.B.5 Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

Career Education:

13.2.11.D Analyze, revise, and apply an individualized career portfolio to chosen career path.

13.3.11.A Evaluate personal attitudes and work habits that support career retention and advancement.

Science:

3.1.12. A. Apply concepts of systems, subsystems, feedback, and control to solve complex technological problems.

Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems.

Apply systems analysis to predict results.

Analyze and describe the function, interaction and relationship among subsystems and the system itself.

Compare and contrast several systems that could be applied to solve a single problem.

Evaluate the causes of a system's inefficiency.

3.2.12. A. Evaluate the nature of scientific and technological knowledge.

Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Understand the properties and applications of copper, PEX, and black iron piping.
- Develop hands-on skills for installation and maintenance.
- Learn safety practices and local plumbing codes relevant to these materials.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Introduction to Plumbing Materials**
 - Overview of plumbing systems and components.
 - Properties and applications of copper, PEX, and black iron.
- **Copper Piping Installation**
 - Types of copper pipes (Type K, L, M).
 - Cutting, fitting, and soldering techniques.
- **Advanced Copper Techniques**
 - Techniques for joining copper pipes (sweating vs. compression).
 - Repair methods for copper piping.
- **PEX Piping Basics**
 - Overview of PEX materials and advantages.
 - Cutting and joining PEX pipes (crimping and clamping methods).
- **Advanced PEX Techniques**
 - Understanding PEX fittings and applications.
 - Troubleshooting common issues in PEX installations.
- **Black Iron Pipe Installation**
 - Applications of black iron piping (gas lines, etc.).
 - Cutting, threading, and joining black iron pipes.
- **Safety and Code Compliance**
 - Safety protocols for working with copper, PEX, and black iron.
 - Overview of relevant plumbing codes and regulations.
- **Combining Materials**

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| <ul style="list-style-type: none"> ○ Techniques for connecting copper, PEX, and black iron. ○ Transition fittings and their applications. ● Troubleshooting and Maintenance <ul style="list-style-type: none"> ○ Identifying leaks and issues in copper, PEX, and black iron systems. ○ Regular maintenance practices for each material. ● Practical Installation Techniques <ul style="list-style-type: none"> ○ Hands-on practice: students install various piping systems using copper, PEX, and black iron. |
| <p>ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):</p> <ul style="list-style-type: none"> ● Students present and execute a final installation project using the three materials. ● Practical skill assessments ● Written quizzes on materials and techniques ● Evaluation of final project |
| <p>DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):</p> |
| <p>RESOURCES (Technology Based Resources, Text Resources, etc.):</p> |
| <p>KEY VOCABULARY: copper pipe, Type K, Type L, Type M, soldering, sweating, compression fitting, pipe cutting, fitting, PEX pipe, crimping tool, clamping method, PEX fittings, pipe expansion, leak detection, troubleshooting PEX, black iron pipe, gas line, pipe threading, pipe cutting, pipe joining, pipe wrench, safety protocols, plumbing codes, local regulations, transition fittings, pipe coupling, pipe joint, pipe repair, pipe insulation, corrosion resistance, pipe sizing, pipe pressure rating, water supply system, drainage system, plumbing fixtures, traps, pipe cleaner, auger, drain snake, caulking gun, basin wrench, plumbing tape, plumbers' putty, backflow preventer, gas leak detector, manifold gauge, soldering kit, water heater, temperature gauge, pipe bender, pipe clamps, installation practices, maintenance schedules, winterizing, water testing kit, permit process, code compliance, inspection checklist, pipe flow control, thermal expansion, press fitting system, pipe thread sealant, pipe sealing techniques, plumbing schematic, plumbing blueprint, plumbing terminology</p> |

| Wallenpaupack Area School District Curriculum | |
|--|-------------------|
| COURSE: Building Trades | GRADE |
| UNIT: Residential Plumbing DVW | TIMEFRAME: |

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Science:

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Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems.

Apply systems analysis to predict results.

Analyze and describe the function, interaction and relationship among subsystems and the system itself.

Compare and contrast several systems that could be applied to solve a single problem.

Evaluate the causes of a system's inefficiency.

3.2.12. A. Evaluate the nature of scientific and technological knowledge.

Know and use the ongoing scientific processes to continually improve and better understand how things work.

UNIT OBJECTIVES (SWBATS):

- Understand the principles of drain, waste, and vent systems.
- Develop hands-on skills for PVC installation, including cutting, fitting, and joining.
- Learn safety practices and plumbing codes relevant to DWV systems.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Introduction to DWV Systems**
 - Overview of drain, waste, and vent systems.
 - Functions and importance of DWV in residential plumbing.
 - Basic plumbing terminology.
- Pipe wrenches
- Tape measures
- **PVC Materials and Applications**
 - Types of PVC pipes and fittings used in DWV systems.
 - Properties and advantages of PVC.
- Pipe cutters
- Utility knives
- **Cutting and Fitting PVC Pipe**
 - Techniques for measuring, cutting, and fitting PVC pipes.
 - Use of solvents and primers in PVC installation.
- PVC pipe cutters
- Deburring tools
- **Joining PVC Pipes**
 - Step-by-step process for solvent welding PVC fittings.
 - Best practices for creating strong, leak-proof joints.
- PVC cement
- Primers
- **DWV System Design Principles**
 - Designing a DWV system layout.
 - Understanding slopes, venting, and trap placement.
- Leveling tools
- Layout tools
- **Installing Waste Lines**
 - Installation techniques for horizontal and vertical waste lines.
 - Addressing common installation challenges.
- Pipe supports
- Clamps
- **Venting Systems**
 - Purpose and design of venting systems.
 - Installing vent pipes and ensuring proper airflow.
- Vent caps
- Hose clamps
- **Building and Installing Traps**
 - Understanding the role of traps in a DWV system.
 - Installing P-traps and S-traps correctly.
- Trap wrenches
- Inspection mirrors
- **Troubleshooting and Maintenance**
 - Identifying common issues in DWV systems (clogs, leaks).
 - Basic troubleshooting and maintenance techniques.
- Drain snakes
- Inspection cameras

- **Local Plumbing Codes and Regulations**
 - Overview of local plumbing codes related to DWV systems.
 - Permitting processes and inspections.
- Code reference materials
- Checklists
- **Practical Installation Project**
 - Hands-on project: Students design and install a small-scale DWV system using PVC.
- Comprehensive toolkit from previous weeks

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Students present their DWV installation projects.
- Evaluation of project design, installation quality, and adherence to codes.
- Practical skill assessments
- Written quizzes on DWV principles and PVC installation
- Evaluation of final project

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

DWV System Overview & Importance

Design a detailed 3D model or interactive diagram of a residential DWV system showing drain, waste, and vent pipes, stacks, and flow paths emphasizing gravity and air balance principles.

Analyze real-world scenarios demonstrating the effects of improper venting or slope causing blockages, odors, or backflow. Present remediation strategies based on hydraulic and fluid mechanics principles.

PVC Materials & Applications

Conduct material property tests comparing PVC to other DWV materials (ABS, cast iron) for durability, corrosion resistance, temperature tolerance, and cost-effectiveness.

Perform hands-on experiments with PVC cutting, solvent welding, and primer use, measuring joint strength and leak resistance to validate best practices.

DWV System Design Principles

Lead a project planning and drawing a DWV layout for a residential building using blueprint software with slope calculations and pipe sizing aligned with plumbing codes.

Use leveling and layout tool kits to simulate pipe runs, trap placements, and vent stack installations considering code compliance and space constraints.

Installation Techniques

Install horizontal and vertical waste lines with support, clamps, and hangers demonstrating load distribution and vibration control.

Practice correct vent pipe installation ensuring proper cap use, clearances, and airflow verification with inspection cameras.

Traps and Maintenance

Install different trap types including P-traps and S-traps ensuring water seals and preventing gas ingress using trap wrenches and inspection mirrors.

Employ drain snakes and camera inspections to identify and clear blockages; document preventive maintenance including vent and trap inspections.

Plumbing Codes and Regulations

Research local DWV code requirements and permitting processes; create code compliance checklists for inspection readiness and documentation.

Conduct mock site inspections to critique DWV installation work, emphasizing code adherence and safety protocols.

Practical Installation Project

Execute a comprehensive hands-on project designing, measuring, cutting, joining, and installing a small-scale DWV PVC system replicating residential standards.

Incorporate learned safety practices, tool maintenance, and quality control checks throughout installation.

RESOURCES (Technology Based Resources, Text Resources, etc.):

KEY VOCABULARY:

circuit vent, air admittance valves, air break, combined building drain, combined building sewer, combined sewer, continuous vent, dead end, developed length, directly connected, drainage system, dual vent, emergency floor drain, fixture, fixture drain, fixture outlet pipe, fixture unit, flood level rim, fresh air inlet, indirectly connected, individual vent, interceptor, nominally horizontal, nominally vertical, nominal pipe size, offset, offset relief vent, private sewage disposal system, private use fixtures, trap, trap arm, trap dip, trap seal depth, trap weir, trap standard, vent header, vent pipe, vent stack, venting system, wet vent, yoke vent, floor drain, discharge tube, dishwasher tailpiece, diverter, drain valve, dual element heater, ECO, EF, vacuum breaker, vacuum relief valve, valve seat, venturi, dope, drop ell.

| Wallenpaupack Area School District Curriculum | |
|---|-------------------|
| COURSE: Building Trades | GRADE |
| UNIT: Residential Plumbing Finish | TIMEFRAME: |

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UNIT OBJECTIVES (SWBATS):

- Understand the types and functions of residential plumbing fixtures.
- Develop hands-on skills for installing sinks, toilets, showers, faucets, and drains.
- Learn about safety practices and plumbing codes related to fixture installation.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

- **Introduction to Plumbing Fixtures**
 - Overview of plumbing fixtures: sinks, toilets, showers, faucets, and drains.
 - Basic plumbing terminology and concepts.
- Pipe wrenches
- Screwdrivers
- **Tools and Materials**
 - Essential tools for fixture installation.
 - Overview of materials used (PVC, PEX, metal fittings).
- Basin wrenches
- Adjustable wrenches
- **Sink Installation**
 - Types of sinks and their applications.
 - Steps for installing a kitchen sink and a bathroom sink.

- Caulking guns
- Plumbers' tape
- **Faucet Installation**
 - Types of faucets and their mechanisms.
 - Step-by-step installation process for various faucet types.
- Basin wrenches
- Allen wrenches
- **Toilet Installation**
 - Understanding toilet components and their functions.
 - Proper installation techniques for various toilet styles.
- Toilet bowl lift tools
- Wax rings
- **Shower Installation**
 - Types of shower fixtures and their configurations.
- Pipe cutters
- Drill and drill bits
- **Drain Installation**
 - Understanding drain systems and their components.
 - Techniques for installing sink, shower, and toilet drains.
- Drain snakes
- Plumber's putty
- **Troubleshooting Fixture Issues**
 - Common problems with fixtures (leaks, clogs).
 - Basic troubleshooting techniques for each type of fixture.
- Inspection cameras
- Pressure gauges
- **Local Plumbing Codes**
 - Overview of local plumbing codes relevant to fixture installation.
 - Understanding permitting and inspection processes.
- Code reference materials
- **Practical Installation Techniques**
 - Hands-on practice: students install a sink, faucet, and toilet in a mock setting.
- Comprehensive toolkit from previous weeks

ASSESSMENTS (Diagnostic/Benchmark/Formative/Summative):

- Collaboratively design and install a complete bathroom setup.
- Review of key concepts and techniques learned throughout the course.
- Final assessment: Practical demonstration of fixture installation.
- Presentation of group project and individual assessments.
- Practical skill assessments for each fixture type
- Written quizzes on fixture installation principles
- Evaluation of group project and individual performance

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Plumbing Fixtures Overview and Terminology

Develop a multimedia presentation reviewing various plumbing fixtures (sinks, toilets, faucets, showers), incorporating detailed technical terminology and function explanations.

Create interactive digital flashcards or an app covering plumbing terms, tools, and component descriptions for peer mini-quizzes.

Tools and Materials Mastery

Lead a hands-on workshop demonstrating the safe, precise use of basin wrenches, adjustable wrenches, pipe wrenches, and caulking guns, including maintenance best practices.

Conduct a comparative analysis of materials used in plumbing fixtures—PVC, PEX, and metal fittings—assessing advantages and application suitability.

Installation Projects

Design and execute a mock kitchen and bathroom sink installation, emphasizing step-by-step procedures, problem-solving plumbing connections, sealing, and testing for leaks.

Develop a video tutorial series showcasing faucet installation types with focus on valve mechanisms and potential troubleshooting points.

Perform a toilet installation project with use of toilet bowl lift tools and wax rings, documenting precise installation criteria and common pitfalls.

Shower and Drain Installation

Construct and present a range of shower fixture configurations, identifying pipe cutters and drill bits required, and best techniques for precise drain installation.

Utilize inspection cameras and drain snakes in lab simulations to detect and address fixture drain issues and clogs effectively.

Troubleshooting and Codes

Lead advanced troubleshooting clinics where students diagnose and fix simulated fixture leaks and clogs supported by pressure gauge readings and video inspections.

Research and present on local plumbing codes relevant to fixture installation, including permitting and inspection processes supported by official code reference materials.

RESOURCES (Technology Based Resources, Text Resources, etc.):

KEY VOCABULARY:

Plumbing fixtures, sinks, toilets, showers, faucets, drains, plumbing terminology, pipe wrenches, screwdrivers, basin wrenches, adjustable wrenches, caulking guns, plumbers' tape, plumbing tools, plumbing materials, PVC, PEX, metal fittings, water supply systems, fixture installation, sink installation, faucet installation, toilet installation, shower installation, drain installation, sealing techniques, caulking, troubleshooting, leak detection, clogs, inspection cameras, pressure gauges, water heaters, soldering kits, temperature gauges, gas line safety, backflow prevention, gas leak detectors, manifold gauges, plumbing maintenance, routine maintenance, winterizing plumbing systems, thermometers, water testing kits, plumbing codes, local codes, permitting process, code reference books, practical installation, hands-on project, plumbing toolkit.