Syracuse City School District
Career and Technical Education Program
HVAC Level 1 Course Syllabus

Program Overview

The heating and air conditioning program is designed to provide students with a comprehensive knowledge of heating, ventilation, air-conditioning, and refrigeration systems including both residential and commercial applications. Mastering installation, troubleshooting, and maintenance practices is central to this program. Students will also explore emerging technologies, Environmental Protection Agency (EPA) requirements and regulations. energy conservation techniques, and systems with exempt and non-exempt refrigerants. Students will balance individual skill development with group development skills including collaboration, communication, critical thinking, creativity, problem solving, perseverance. Students will develop clear communication skills, both written and spoken and an awareness of issues around diversity, ethical business practices, and social responsibility. Completion of this sequence will prepare students for employment in a variety of heating, ventilation, air-conditioning, and refrigeration occupations. Students will also obtain, at minimum, certification in OSHA 10 safety protocols and EPA Section 608 certification.

Course Description

The first year provides a foundation for safe practices and an overview of the industry and careers. Students will learn about opportunities in the field and start to identify and document their skills and accomplishments. Learning about tools and safety protocols are integrated into the study of heat, energy, electricity, and refrigeration. Through learning about design of systems and interpreting blueprints, students start to apply theory to practice as they work with sheet metal, circuits, and controls.

Work-Based Learning

Throughout the entire program sequence, students will be connected with local and national professionals throughout their learning experiences especially as they complete project-based learning experiences. These professional connections may include interviews, field trips to local businesses, virtual field trips to other locations, presenting their learning and work samples to professionals, job shadowing and career coaching. It is expected that these experiences will lead to opportunities for direct job training and real-world experience in an internship experience prior to completion of the program. Students will create and maintain a portfolio of their experiences to document the development of their skills, including a professional resume.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the project that they are involved in. Some examples for this pathway include, but are not limited to:
    - Power tool safety
    - Laddering safety
    - OSHA 10 hour
    - EPA Section 608

- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

N/A

Course Objectives

Upon completion of this course students will know and be able to:

- Name potential careers withing Heating, Ventilation, Air Conditioning (and Refrigeration).
- Demonstrate safety protocols and procedures.
- Demonstrate safe use of basic hand and power tools.
- Describe theories for heat and energy.
- Explain the concept of electricity and associated laws.
- Explain basic circuits and formulas to obtain additional information.
- Interpret schematics and blueprints.
- Apply skills to layout and manipulate sheet metal.
- Demonstrate accurate measurement skills.
- Demonstrate effective communication, team work, time management, problem solving, creativity and awareness of diversity.

Integrated High School Academics

N/A

Concurrent College Enrollment

TBD

Equipment and Supplies

- **School will provide:** All tools including technology, equipment and supplies to complete projects
- **Student will provide:** N/A

Textbook

TBD

Grading

10% Classwork assignments
10% Tests/quizzes
80% Projects and presentations, (rubric)

Additional Course Policies

Students are expected to:

- Meet all deadlines and be on time. Deadlines and being on time are a major part of being a professional.
- Produce their best work, including being prepared for presentations.
- Participate in class including contributing to discussions and critiquing their own and others' work, as well as diligently working on their own projects.
- Seek help when needed.
- Be attentive, ask questions if they do not understand something, and offer their opinions.
- Demonstrate responsible and safe use of all equipment.
- Use identified technology hardware and software for preparing and sharing all work.
- Give credit and use proper citations for all research and project ideas.

Course Calendar

Quarter	Units of Study
1	● Introduction to Class Expectations and Policies ● Introduction to HVAC ● Shop Safety: PPE, Use and Storage of Materials and Tools, Fire Safety, Use of Hand and Power Tools, Laddering, First Aid, ● OSHA 10 Certification ● Introduction to Heat and Energy ● Electrical Theory and Current ● Working Safely with Electricity
2	● Basic Laws of Electricity ● Circuits ● Interpreting a Schematic ● Introduction to Sheet Metal ● Measurement
3	● Reading Blueprints ● Career Exploration/Job Shadowing and Coaching ● Sheet Metal Layout
4	● Sheet Metal Fabrication ● Series and Parallel Circuits ● Low Voltage Controls ● Reflection

Syracuse City School District
Career and Technical Education Program
HVAC Scope and Sequence
Level 1

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1 **Introduction to Class Expectations and Policies** **Introduction to HVAC**	• What are the expectations for students in the HVAC program? • What is HVAC? • What are different careers available in HVAC and what types of skills do they require? • What are the financial and professional benefits of pursuing a career in this field? • What is the typical career path for HVAC professionals? • What are student goals for career and learning outcomes?	• Develop classroom rules and establish relationships. • Define HVAC. • Identify several careers available in HVAC. • Name key aspects for HVAC careers. • Identify key skills and traits required within this profession. • Analyze typical earnings and benefits of a career in this field. • Identify local, regional, and national employers. • Name what education, certifications and experiential requirements are for a career within this field. • Identify personal goals for long-term career and short-term learning. • Develop a professional portfolio.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio • Career Interest Survey • Written Reflection **Performance** • Class Presentation • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,10 **Cluster Standards** AC 7 **Pathway Standards**	**ELA** 9-10 R 1 9-10 W 6,7 9-10 SL 1,2,4,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2,3,4 **Math/ Science**
Weeks 2-5 **Shop Safety:** • **PPE**	• What are the causes and consequences of the most common types of workplace incidents? • How is PPE (personal protection equipment) used to protect workers from different types of injuries?	• Describe the causes and consequences of the most common types of workplace incidents. • Explain the benefits of safety, the cost of workplace incidents, and ways to reduce related hazards. • Explain how and when PPE is used to protect workers from different types of injuries.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes • First Aid and CPR Certification • OSHA 10 Hour Certification **Performance**	**Career Ready Practices** CRP 1 **Cluster Standards** AC 3	**ELA** 9-10 R 1,4 9-10 W 2,5,6,7 9-10 SL 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2,5

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• **Use and Storage of Materials and Tools** • **Fire Safety**	• What are examples of job-site hazards? • Why is it important to store materials and tools in their proper places? • Where should hazardous materials be stored? • What information can be found on an SDS? • What are the three things necessary to start a fire? • What information does the fire triangle and the fire tetrahedron provide? • Why do fires have different classifications, and what are they? • Why is it important to know the classification of fire when trying to extinguish it? • What are the classifications of extinguishers? • Why should extinguishers be inspected, and how often should they be inspected?	• Demonstrate the use and care of appropriate personal protective equipment, including: eye protection, respirator, hard hat, gloves, safety harness, and safety shoes. • Describe common environmental hazards and how workers should respond to them. • Explain the importance of following safety protocols for the care and storage of materials and tools. • Identify safe storage protocols for hazardous materials. • Explain the importance of safety data sheets (SDS). • Interpret a SDS and summarize it. • Articulate what is required for a fire. • Summarize the information found on the fire triangle or fire tetrahedron. • Identify the types of fires and the methods used to extinguish them. • Identify fire hazards and describe basic firefighting procedures. • Demonstrate extinguishing a fire matching the type of fire with the appropriate type of extinguisher. • Articulate how to inspect fire extinguishers.	• Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Pathway Standards** AC-CST 5 AC-CST 9	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• **Use of Hand and Power Tools** • **Laddering and Lifting**	• What are the guidelines for the safe use of hand and power tools? • Why should a power tool always be grounded? • What is a tag out lock out procedure? • Who keeps the key to the lock? • Whose name goes on the tag? • If more than one person is working on the equipment, who should have a lock and key? • How can injuries be prevented while lifting? • What are different types of ladders and purposes. • Why are ladders rated for certain weights? • How can a ladder be used safely? • In what situations is scaffolding preferred or required?	• Identify common hand tools and demonstrate how to use them safely. • Identify and explain how to use common power tools. • Summarize basic power tool safety guidelines. • Identify components of machinery (e.g., guards, blades, moving parts, start/stop switches) • Identify standard safety procedures (i.e., lab practices and manufacturer recommendations) • Explain the safe operation and use of each piece of machinery in the lab • Identify tag out lock out procedures for who has the key and whose name is on tag. • Demonstrate lockout and tagout procedures for use with any equipment connected to power source. • Define safe work procedures around electrical hazards. • Compare and contrast safe and improper lifting techniques. • Demonstrate positioning and techniques to prevent injury while lifting and carrying equipment. • Name type and purpose of different style ladders. • Summarize safe use of a ladder (ladder adjustment, not using			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
● **First Aid** **OSHA 10 Certification**	● Why is it important to be certified to administer first aid? ● What are basic first aid procedures? ● Why is knowing cardiopulmonary resuscitation (CPR) an important skill? ● What are the different degrees of electrical burns? ● What is the role of the OSHA (Occupational Safety and Health Administration) in job-site safety? ● What benefits are associated with having the OSHA 10 Hour Certification? ● Why is it important to follow reporting procedures? ● What are the steps that should be followed an accident?	the apex as step, adhere to weight limits, etc.). ● Identify situations where scaffolding is necessary or preferred. ● Demonstrate safe use of ladder and scaffolding. ● Explain the purpose of first aid. ● Locate first aid equipment and emergency numbers. ● Identify emergency first-aid procedures. ● Demonstrate application of standard first-aid procedures while following any school policies regarding administration of first aid and protections. ● Demonstrate proficiency by obtaining first aid and CPR certification. ● Name the types of electrical burns and associated first aid for each. ● Summarize the purpose of OSHA and why it was established and how it has evolved. ● Explain the role of the OSHA in job-site safety. ● Articulate benefits of OSHA 10 certification as demonstrating safety skills to the industry. ● Demonstrate proficiency in basic safety protocols through OSHA 10 certification. ● Define liability.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Articulate the importance of timely and accurate reporting of an incident. ● Justify any ethical considerations that might be involved in making a report that involves coworkers. ● Summarize when, to whom and what details need to be included for any report of personal injuries, environmental issues, and equipment safety violations to the appropriate authority.			
Weeks 6-7 **Introduction to Heat and Energy**	● What are the different states of matter? ● What are the effects of heat on evaporation, condensation, and sublimation? ● What do Charles, Dalton and Boyle's laws help determine? ● What is the refrigeration process? ● What are the basic components for refrigeration?	● Describe the changing states of matter. ● Define evaporation, condensation, compression, and sublimation. ● Describe the effects of heat on evaporation, condensation, and sublimation. ● Define Charles's Law, Dalton's Law, and Boyle's Law. ● Compare and contrast the gas laws. ● Name what each gas law helps determine. ● Describe the refrigeration process and the basic refrigeration components including identification of components of the mechanical refrigeration system (e.g., compressor, condenser coil, metering device, evaporator coil) and details related to evaporation, condensation, and compression.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices CRP 2** **Cluster Standards AC 1** **Pathway Standards**	**ELA** 9-10 R1,4 9-10 R W 2,5,6,7 9-10 SL 1,2,4,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• What are common types of compressors? • What is the saturation temperature of R-22 and other current refrigerants at 50 psig? • When does temperature and pressure of a gas matter? • What is the temperature-pressure relationship? • How is a pressure/temperature chart read? • What is a BTU? • Why is it important to HVAC industry? • What are the differences between latent and sensible heat?	• Describe the relationship between heat and the condenser coil or compressor (heat release) and evaporator (heat absorb). • Identify common compressor types and how each function. • Interpret a pressure/temperature chart (P/T). • Describe the relationship of pressures and fluids at saturation temperatures. • Identify the British thermal unit (BTU) and types of heat. • Articulate HVAC applications of BTUs, or the standard measuring unit of energy. • Compare and contrast the difference between latent and sensible heat.			
Weeks 8-12 **Basic Electricity:** • **Electrical Theory and Current**	• What is electricity? • How does electricity move through a circuit? • What are basic components for working with electrical circuits? • What role does a conductor and insulator have in electricity? • What are 4 elements of a simple circuit? • How do an open and closed circuit differ? • What are key terms used in measurement of current?	• Explain the flow of electrons creating electricity. • Explain positive and negative terminals. • Define conductors, insulators, resistors, capacitors, inductors. • Explain the function of a conductor and insulator. • Identify power source, conductor, switch, and load as elements of a circuit. • Compare and contrast an open and closed circuit. • Define amperage, volts, Ohms, Watts–	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 1,3,6 **Pathway Standards** AC-CST 5,9	**ELA** 9-10 R 1,4 9-10 W 2 9-10 SL 1,2,4,5,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
● **Working Safely with Electricity**	● What are the two types of current? ● What are safe working clearances, according to the National Electrical Code (NEC)? ● What are some common electrical workplace issues? ● What are considered safe working conditions and safe work habits? ● How does electric shock happen? ● What purpose do ground wires serve? ● What is the importance of ground fault circuit interrupters? ● Why is awareness of conductors and insulators important for safe practices?	● Compare and contrast AC and DC current. ● Define proximity work. ● Explain safe working practices around electrical hazards(e.g., grounding, using ground-fault circuit interrupters [GFCIs] and cords). ● Identify equipment used to test electrical circuits ● Demonstrate safe work habits including ways to protect yourself from electric shock. ● Explain how ground fault circuit interrupters work. ● Compare and contrast the purpose of conductors and insulators.			
● **Basic Laws of Electricity**	● What is Ohm's Law? ● How is Ohm's Law calculated? ● How is Ohm's Law applied? ● What is Watts Law? ● What is the relationship between these laws and or watts, volts, amperage and ohms?	● Define Ohm's Law. ● Explain what information Ohm's law provides. ● Define Watts Law. ● Explain what information Watts Law provides. ● Demonstrate application of power formulas and calculations.			
● **Circuits**	● What are types of circuits? ● What is the formula for calculating a series circuit?	● Identity series and parallel circuits. ● Demonstrate use of an ammeter.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
● ● ● ● ● **Interpreting a Schematic**	● What is the formula for calculating a parallel circuit? ● What measuring devices enable these calculations? ● How are differences between computed and measured values reconciled? ● What is the purpose of a schematic? ● What are the common electrical symbols in a schematic? ● What is the difference between a schematic and a pictorial diagram? ● What is a legend, and why is it helpful?	● Demonstrate calculation of voltage, amperage, and resistance in series and parallel circuits. ● Demonstrate use of manual formulas, specific calculators and reviewing rounding to reconcile any differences. ● Explain what a schematic is and its purpose. ● Identity and define common electrical symbols from a schematic. ● Compare and contrast a schematic and a pictorial diagram. ● Create a drawing with basic electrical symbols and corresponding legend.			
Week 13 **Introduction to Sheet Metal**	● What are common sheet metal materials? ● How is manipulation of sheet metal related to HVAC? ● What tools and machines are used with sheet metal? ● How is sheet metal processed?	● Name types of materials: steel, stainless steel, aluminum, zinc, copper. ● Name uses of sheet metal for applications such as ductwork. ● Identify basic tools such as snips, hammer, anvil, scratch awl, and rulers. ● Demonstrate safe use of basic hand tools. ● Name ways that sheet metal is processed.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** **AC 3** **Pathway Standards** AC-CST 9	**ELA** 9-10 SL 1,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 14-18 **Measurement**	● How are whole numbers, fractions, decimals and percents related? ● When might one need to convert a decimal to a percentage? ● When might one need to convert a fraction to a decimal or a decimal to a fraction? ● Why might it be easier to multiply a decimal rather than a fraction? ● When are conversions commonly used? ● How are fractions, decimals, and percents added, subtracted, multiplied, and divided? ● Why is accurate measurement critical? ● What tools are used to measure? ● How can one tell what is the best measurement tool to use? ● How are measurements expressed? ● How are measurements added and subtracted? ● How are measurements split? ● When might one need to convert a decimal to a percentage? ● When are conversions commonly used?	● Compare and contrast the relationship between whole numbers, fractions, decimals and percents. ● Explain place value with whole numbers and decimals. ● Convert decimals to percents and percents to decimals. ● Convert fractions to decimals and decimals to fractions. ● Define equivalent fractions and calculate their lowest common denominators. ● Define improper fractions and convert them into mixed numbers. ● Calculate and solve problems with whole numbers, fractions and decimals. ● Identify common length, weight, volume, and temperature units in both the inch-pound and metric systems and convert them into other comparable units. ● Identify varied measurement tools and what type of measurement they provide. ● Identify and demonstrate the use of common length-measuring tools (tape measure, folding ruler, flat rule framing square, speed square. ● Calculate and solve measurement problems with whole numbers, fractions, and decimals.	**Written** ● Self-Assessment ● Class Assignments/ ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 1 **Pathway Standards**	**ELA** 9-10 SL 1,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● When might one need to convert a fraction to a decimal or a decimal to a fraction? ● Why might it be easier to multiply a decimal rather than a fraction? ● What causes improper measurements?	● Demonstrate conversion of units to simplify math calculations. ● Explain potential problems with inaccurate measurement.			
Weeks 19-24 **Reading Blueprints**	● What are the basics of construction drawing? ● What are different types of plans and drawing? ● What are the basic electrical, mechanical, and plumbing symbols used on plans? ● What is the importance of scale? ● What is the purpose of written specifications?	● Identify basic blueprint terms, abbreviations, components, symbols, and scale. ● Identify classifications of drawings such as civil, architectural, structural, mechanical, plumbing. ● Identify selected electrical, mechanical, and plumbing symbols commonly used on plans. ● Identify selected abbreviations commonly used on plans. ● Explain how dimensions relate to scale. ● Explain the function of specifications especially as relates to HVAC. ● Demonstrate interpretation of blueprint or scale drawing.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 1,6 **Pathway Standards**	**ELA** 9-10 R 4 9-10 SL 1,2,4,5,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**
Weeks- 24-25 **Career Coaching/ Job Shadowing**	● What can be learned from industry professionals?	● Generate questions regarding industry and careers. ● Summarize experience interviewing or shadowing a professional in the industry.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Interview	**Career Ready Practices** CRP 1,10	**ELA** 9-10 W 2,6,7 9-10 SL 1,2,3,4,6 9-10 L 1,2,3,4,6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Synthesize how the interview and job shadow experience supports personal learning and career goals.	● Written Reflection **Performance** ● Class Presentation ● Interview ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Cluster Standards** AC 7	**Literacy** 9-10 RST 1,2,4 9-10 WHST 2,3,4,5
				Pathway Standards	**Math/ Science**
Weeks 27-32 **Sheet Metal Layout**	● Why is accuracy essential? ● How do drawings, stretches and blueprints translate to a product? ● How is sheet metal layout accomplished?	● Explain the impact of accuracy and inaccuracy. ● Demonstrate application of drawing, sketches, and blueprints on the layout. ● Demonstrate accuracy measuring and marking a layout on metal. ● Demonstrate use of tools such as scratch awl, steel scale or straight edge, flat steel square and combination square, protractor, prick punch, dividers, trammel points. ● Demonstrate cutting metal according to layout.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2	**ELA** 9-10 SL 1,4 9-10 L 1,4,6
				Cluster Standards AC 1,2,6	**Literacy**
				Pathway Standards AC-CST 9	**Math/ Science**
Weeks 32-37 **Sheet Metal Fabrication**	● How is sheet metal manipulated? ● What is deformation of sheet metal? ● How is sheet metal assembled?	● Explain a cutting process such as: laser, water jet , plasma, or punching ● Explain label procedures. ● Demonstrate cutting metal according to layout. ● Explain deformation of metal. ● Demonstrate bending metal with use of a break. ● Explain other ways to deform metal such as: stamping, spinning, wheeling, and rolling.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2	**ELA** 9-10 SL 1,4 9-10 L 1,4,6
				Cluster Standards AC 2	**Literacy** 9-10 RST 1,2,4 9-10 WHST 2
				Pathway Standards AC-CST 9	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Explain how metal is assembled with fasteners such as bolts, screws, rivets, or welding. • Demonstrate assembly of metal with fasteners such as bolts, screws, rivets.			
Week 38 **Series and Parallel Circuits**	• What are series circuits? • What are parallel circuits? • What is the relationship between current and resistance? • How is current and resistance measured?	• Define types of circuits. • Compare and contrast series and parallel circuits. • Explain current voltage and resistance. • Demonstrate measurement of current.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 1 **Pathway Standards** AC-CST 3	**ELA** 9-10 SL 1,4 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**
Week 39 **Low Voltage Controls**	• What is a thermostat? • What are different types of thermostats? • How do controls work? • What type of wiring is required? • How do schematics support installation and operation?	• Explain how thermostats work. • Identify different types of thermostats (programmable, non-programmable, Wi-fi, smart). • Identify basic wiring for thermostats. • Interpret a schematic for basic installation. • Demonstrate installation and operation of a thermostat.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** **Pathway Standards** AC-CST 9	**ELA** 9-10 SL 1,4 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 40 **Reflection**	● How might personal goals need to be revised? ● How is learning and skill acquisition documented?	● Articulate goals, accomplishments, and make revisions. ● Communicate skills and knowledge through employability profile, resume and portfolio.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Career Interest Survey ● Written Reflection **Performance** ● Class Presentation ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,,4,10 **Cluster Standards** AC 7 **Pathway Standards**	**ELA** 9-10 W 3 9-10 SL 1,4,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 WHST 3,4 **Math/ Science**

Syracuse City School District
Career and Technical Education Program
HVAC Level 2 Course Syllabus

Program Overview

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Course Description

The second year builds upon the first year with students learning deeper about application of electricity and associated tools. Students have the opportunity to work with motors and controls, compressors, piping and fittings, including fasteners and adhesives. The theory, history and foundational knowledge and skills to maintain and service air conditioning and refrigeration systems is a focus. Students continue to hone their skills working with sheet metal and measurement. Work with heat pumps is introduced as an increasingly utilized system.

Work-Based Learning

Throughout the entire program sequence, students will be connected with local and national professionals throughout their learning experiences especially as they complete project-based learning experiences. These professional connections may include interviews, field trips to local businesses, virtual field trips to other locations, presenting their learning and work samples to professionals, job shadowing and career coaching. It is expected that these experiences will lead to opportunities for direct job training and real-world experience in an internship experience prior to completion of the program. Students will create and maintain a portfolio of their experiences to document the development of their skills, including a professional resume.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the project that they are involved in. Some examples for this pathway include, but are not limited to:
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  - OSHA 10 hour
  - EPA Section 608
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

HVAC Level 1

Course Objectives

Upon completion of this course students will know and be able to:

- Name potential careers withing Heating, Ventilation, Air Conditioning (and Refrigeration).
- Demonstrate safety protocols and procedures.
- Demonstrate safe use of basic and power tools.
- Apply knowledge of electricity to implement the use of tools, calculations and troubleshooting.
- Demonstrate proficiency using motors and controls.
- Demonstrate use of and troubleshooting of compressors.
- Identity piping, fittings, adhesives, fasteners, hangers and supports.
- Identify type of air conditioning systems.
- Connect local history to air conditioning.
- Summarize environmental concerns and regulations regarding use of refrigerants.
- Demonstrate maintenance and service of cooling systems.
- Explain circumstances for the effectiveness and efficiency of heat pumps.
- Develop advanced skills with sheet metal layout and fabrication.
- Explain air intake systems.
- Develop accurate measurement skills.
- Demonstrate effective communication, team work, time management, problem solving, creativity and awareness of diversity.

Integrated High School Academics

N/A

Concurrent College Enrollment

TBD

Equipment and Supplies

- **School will provide:** All tools included technology, equipment and supplies to complete projects
- **Student will provide:** N/A

Textbook

TBD

Grading

10% Classwork assignments
10% Tests/quizzes
80% Projects and presentations, (rubric)

Additional Course Policies

Students are expected to:

- Meet all deadlines and be on time. Deadlines and being on time are a major part of being a professional.
- Produce their best work, including being prepared for presentations.
- Participate in class including contributing to discussions and critiquing their own and others' work, as well as diligently working on their own projects.
- Seek help when needed.
- Be attentive, ask questions if they do not understand something, and offer their opinions.
- Demonstrate responsible and safe use of all equipment.
- Use identified technology hardware and software for preparing and sharing all work.
- Give credit and use proper citations for all research and project ideas

Course Calendar

Quarter	Units of Study
1	● Class Expectations and Policies ● Safety Review ● Application of Electrical Theory ● Motors and Controls ● Math and Measurement
2	● Power Tools ● Piping and Fitting ● Introduction to Air Conditioning and Cooling Systems: Tools, AC Systems, Refrigerants and Types of Systems ● Compressors
3	● Servicing and Maintaining Cooling Systems ● Heat Pumps
4	● Career Exploration ● Sheet Metal ● Fresh Air Intake ● Auxiliary Views ● Fasteners and Adhesives ● Hangers and Supports ● Reflection

Syracuse City School District
Career and Technical Education Program
HVAC Scope and Sequence
Level 2

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1-2 **Class Expectations and Policies** **Safety Review**	• What are the expectations for students in the HVAC program? • What are personal learning goals towards a career? • What are key safety concepts? • How is basic first aid administered? • Why is a SDS (Safety Data Sheet) important? • What is the National Electric Code (NEC)? • How is safety maintained in a job-site or lab?	• Develop classroom rules and establish relationships. • Articulate goals towards a career of choice. • Explain use of PPE, fire and electrical safe practices, safe use of hand and power tools, lifting and laddering safety. • Demonstrate use of basic first aid. • Demonstrate proper use and care of PPE and tools (hand and power). • Complete a SDS form. • Complete an accident report. • Articulate what the NEC is and what safety guidelines it provides. • Demonstrate in daily practice safety protocols such as identifying and mitigating potential hazards and unsafe practices.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Professional Portfolio • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,10 **Cluster Standards** AC 7,3 **Pathway Standards** AC-CST 5	**ELA** 9-10 R 1 9-10 SL 1,4,5,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2,4 **Math/ Science**
Weeks 3-4 **Application of Electrical Theory**	• What are foundational laws, definitions, and components of electricity? • Why is the size of wiring important? • How does gauge size correlate to capacity?	• Articulate the theory and relationships between basic laws, components, and elements of electrical theory. • Define AWG (American Wire Gauge) and what is the most commonly used gauge.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation	**Career Ready Practices** CRP 2 **Cluster Standards**	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• What are the minimum and maximum load ratings for air-conditioning units? • What tool is used to measure voltage? • What voltages are associated with residential power supplies? • How is voltage measured? • What is amperage? • What meter is used to measure amperage? • Where is the amperage rating found on a piece of equipment? • How is resistance measured? • What is the symbol for resistance? • What is the relationship between continuity and resistance? • What piece of equipment measures continuity? • What is the difference between an open and a closed circuit? • What is the relationship between a ground, open and short? • Why should the ground, open, and short be tested? • Why is it important to test the compressor windings?	• Explain the relationship between load ratings/ wiring and safety • Demonstrate determination of the appropriate wire size, based on equipment load amperage. • Demonstrate use of the National Electrical Code (NEC) to confirm specifications. • Identify a VOM (volt-ohm meter). • Identify expected voltage for residential power supplies. • Demonstrate measuring voltages in electrical circuits. • Define amperage. • Identify an ammeter. • Demonstrate using an ammeter to measure amperage in electrical circuits. • Explain why knowing the amperage is important. • Identify tool and symbol used to measure resistance. • Demonstrate safe and accurate measurement of resistance in electrical circuits using an ohmmeter or multimeter. • Compare and contrast continuity and resistance. • Demonstrate safely testing for circuit continuity using an ohmmeter. • Explain why results will differ when testing an open or closed circuit.	• Projects • Class Assignments • Teacher Observation/ Checklist	AC 1 **Pathway Standards** AC-CST3,9	9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• Where are the start, run, and common terminals located on a compressor? • How is the resistance in the windings determined? • How is testing done for a ground, open, and short on a compressor or motor be completed? • How is capacitance measured? • What is the unit of measurement for capacitance? • What kinds of capacitors are available? • What type of meter can check a capacitor? • What materials are used in connections? • How does color coding of wires and connections assist? • Why are tight and secure connections important? • How are connections made? • What is the function of a circuit breaker? • What precautions should be taken before installing electrical components? • What procedures need to be followed when trouble shooting either high-voltage or low-voltage electrical systems?	• Compare and contrast ground, open and short. • Explain why testing is important. • Demonstrate testing a compressor/motor and motor windings for grounds, open and shorts including checking common start, and run terminals using an ohmmeter. • Define capacitance. • Identify what tool is used to measure capacitance. • Identify the symbol C. • Define Farad. • Articulate types of capacitors in use today. • Demonstrate measurement of capacitance by safely checking capacitors for proper mF and voltage, using an ohmmeter and/or capacitor checker. • Identify materials used in connections. • Explain the purpose of color coding wires and how it supports efficiency and safety. • Demonstrate making electrical connections according to circuit and materials, including testing before and after connections are made. • Explain the positions and function of a circuit breaker • Demonstrate installation of electrical components adhering to NEC and safety protocols.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Demonstrate troubleshooting by using the appropriate electronic testing equipment, following manufacturer specifications, and applying all safety protocols			
Weeks 5-7 **Motors and Controls**	● What are single phase motors? ● How are single phase motors connected safely? ● Why and how might rotation of a single-phase motor be reversed? ● What procedure is used to troubleshoot starting a single-phase motor? ● When is a hard-start kit necessary? ● Where would the wiring be installed when using a hard-start kit? ● What size hard-start kit should be installed? ● How might a hard-start kit be installed on a hermetic compressor? ● What components on a motor contactor fail? ● What electrical data is needed before installing a contactor? ● What is the capacitance rating? ● What is the physical difference between a start and a run capacitor? ● What causes a capacitor to short out?	● Describe single phase motors and associated common voltages. ● Demonstrate connecting various types of single-phase motors, referring to the manufacturer's procedures corresponding to available voltage. ● Identity equipment used to reverse rotation of a single-phase motor. ● Explain why a rotation might need to be reversed. ● Demonstrate reversing the rotation of a single-phase motor following instructions on the manufacturer's data plate. ● Identify starting components of a single-phase motor. ● Demonstrate checking starting relays, capacitors and overloads, in a safe manner. ● Demonstrate installation of an appropriate hard start kit including correct wiring, and connections, according to the schematic and manufacturer instructions; installing and fastening the cover containing the start capacitor; connecting the wires of the new	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** **Pathway Standards** AC-CST 3,9	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● What are the types of start relays? ● When should start relays be replaced? ● What is the function of the overload protector?	compressor harness to the terminals and re-mounting the terminal cover onto the compressor and securing it. ● Identify components on a contactor. ● Demonstrate installation of a motor contactor including making all wiring connections and checking voltage and amperage safely. ● Determine capacitance rating. ● Compare and contrast a start and a run capacitor. ● Explain what causes a capacitor to short out. ● Demonstrate replacement of a start or run capacitor. ● Identify types of start relays. ● Demonstrate replacement of a starting relay including testing the voltage and amperage on the device, keeping the relay cover in place, disconnecting power supply, labeling each wire as it is disconnected, and mounting the thermostat to a solid surface. ● Demonstrate using an ohmmeter and ammeter to determine when the overload protector is bad or overheated. ● Demonstrate replacement of a motor overload protector.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 7-10 **Math and Measurement Review**	● How are whole numbers, fractions, decimals and percents related? ● How are fractions, decimals, and percents added, subtracted, multiplied, and divided? ● When might one need to convert a decimal to a percentage? ● When might one need to convert a fraction to a decimal or a decimal to a fraction? ● When are conversions commonly used? ● Why might it be easier to multiply a decimal rather than a fraction? ● How are measurements added and subtracted? ● How are measurements split? ● What causes improper measurements? ● Why is accurate measurement critical?	● Compare and contrast the relationship between whole numbers, fractions, decimals and percents. ● Define equivalent fractions and calculate their lowest common denominators. ● Define improper fractions and convert them into mixed numbers. ● Explain place value with whole numbers and decimals. ● Calculate and solve problems with whole numbers, fractions and decimals. ● Convert between decimals, fractions, and percentages. ● Demonstrate the use of instruments for measurement. ● Demonstrate application of calculation skills to add, subtract, multiply and divide units of measurements. ● Articulate what the consequence of mismeasurement might be.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 1 **Pathway Standards**	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**
Week 11 **Power Tools**	● What are common power tools? ● What are safety guidelines for power tools? ● What is lock-out tag out procedure?	● Identify common power tools such as: cordless drill, electric shears, radius shears, and drill press. ● Articulate safety procedures. ● Demonstrate responsible use and care of power tools. ● Demonstrate lock out tag out procedures.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments	**Career Ready Practices** **CRP 1,2** **Cluster Standards** **AC 3** **Pathways Standards** **AC-CST 9**	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
			• Teacher Observation/ Checklist		
Weeks 12-14 **Piping and Fitting**	• What types of materials are commonly used for piping? • What are the applications of different materials? • How is it determined what type of industry fitting to match the material?	• Identify types of materials used for piping (copper, steel, PVC, PEX). • Compare and contrast aspects of different types with benefits and applications for each type. • Name where to find resources to find alignment for piping and fittings. • Match industry fittings appropriate for each material of piping.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2 **Pathway Standards**	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**
Weeks 15-17 **Introduction to Air Conditioning and Cooling Systems: Tools, AC Systems, Refrigerants, and Types of Systems**	• What tools are commonly used in refrigeration systems? • How can two metals be joined? • How does refrigeration work? • What components make up a refrigeration system? • How is Syracuse, NY historically connected to the development of cooling systems? • What are refrigerants? • What is the environmental impact of refrigerants?	• Identify tools used to measure, cut, and repair refrigeration systems. • Demonstrate safe and responsible use, cleaning, and storage of tools. • Describe the process of brazing. • Demonstrate brazing. • Explain the process of refrigeration. • Identify components within a refrigeration system. • Summarize the importance of the invention of AC and the impact on society. • Summarize the role of Carrier Corporation in the development of AC and history of this region. • Name refrigerants used in the past and current allowable ones.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2,7 **Cluster Standards** AC 3 **Pathway Standards** AC-CST5,9	**ELA** 9-10 R 1 9-10 W 2,5,6,7 9-10 SL 1,3,4,5,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● How has the industry responded to environmental concerns? ● What are current regulations regarding type and use of refrigerants? ● What is the impact on the industry when regulations change? (ie 2023 change in refrigerants) ● What are different types and purpose of refrigeration systems?	● Draw connections between ozone, ozone depletion and global warming. ● Discuss the impact of refrigerants on the environment and global warming. ● Identify current regulations regarding use of refrigerants. ● Explain the costs and benefits to the industry when regulations change. ● Compare and contrast central air systems, residential refrigeration and commercial refrigeration. ● Name uses of commercial refrigeration in manufacturing and other processes.			
Week 18 **Compressors**	● How do compressors work? ● What are types of compressors? ● How do compressors function? ● How is which compressors used determined? ● How do compressors stay cool?	● Explain the function of compressors. ● Name types of compressors. ● Explain the purpose of compressors and how each type works. ● Compare and contrast types of compressors for efficiency, cost and common application. ● Identify specific oils to use with specific compressors and/or refrigerants. ● Demonstrate checking oil level. ● Demonstrate adding oil to a compressor.	Written ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes Performance ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practice CRP 2** **Cluster Standards** **Pathway Standards** AC-CST 3,9	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 19-28 **Servicing and Maintaining Cooling Systems**	● What routine service needs to be performed on refrigeration systems? ● How is it determined if an electrical or mechanical problem needs to be primarily addressed? ● What information does a manifold gauge provide? ● How is superheat and supercooling measured? ● How are leaks detected in a charged system? ● How are leaks detected in an uncharged system?	● Locate coils to clean. ● Identify the frequency for coils to be cleaned. ● Identify other components requiring regular maintenance. ● Demonstrate routine maintenance of refrigeration systems with a standard cleaning including checking and adjusting superheat and subcooling. ● Name examples of common mechanical problems. ● Name examples of common electrical problems. ● Compare and contrast mechanical and electrical problems. ● Demonstrate troubleshooting to determine source of problem. ● Explain the difference between a high-pressure and low-pressure gauge. ● Demonstrate connection and accurate reading of a refrigeration manifold gauge. ● Identify common superheat temperatures for air conditioners. ● Demonstrate measurement of superheat and subcooling and adjusting as warranted. ● Identify ways to detect leaks. ● Determine which detection method to use according circumstance	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,8 **Cluster Standards** AC 2,3 **Pathway Standards** AC-CST 3,5,9 AC-MO 2,3,5,6	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4,8 9-10 WHST 2,5 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Demonstrate locating a leak in charged refrigerant circuits, using various leak detection methods. ● Demonstrate locating a leak in an uncharged refrigerant circuit, using nitrogen pressurization or trace gas observing all safety precautions.			
	● What is the function of a filter drier and suction filter? ● When do filter driers or suction driers need to be replaced?	● Compare and contrast the function of filter drier and suction filter. ● Identify how to determine if the filter needs replacement. ● Demonstrate replacement of a filter drier including identifying the moisture capacity and size, and articulating the reason for replacement.			
	● What might contaminate a system? ● What evacuation methods should be used on a new or contaminated system? ● What are the EPA regulations regarding refrigerant leaks?	● Identify potential contaminates in a cooling system. ● Demonstrate evacuation and charge of a refrigeration circuit (new or contaminated system) using a pressure gauge and a micron gauge. ● Explain the importance of fixing leaks of refrigerants. ● Explain the role of the EPA and why regulations were established. ● Demonstrate repair of a leak in a refrigerant circuit by brazing or soldering tubing, repairing or replacing fittings of mechanical devices			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• What is a pressure switch and how is it used? • How is temperature regulated? • How is a compressor changed? • What are the disposal regulations for a compressor? • What are some of the differences between residential and commercial cooling systems?	• Demonstrate adherence to EPA regulations. • Demonstrate adjusting pressure to turn on an operating refrigeration system. • Demonstrate adjusting the temperature switch in varied environments such as window air conditioner, small refrigeration system and wall thermostat. • Articulate conditions for replacing a compressor. • Articulate regulations and protocols for disposal of compressors. • Demonstrate replacement of a compressor including evacuation and recharging the system. • Compare and contrast residential and commercial cooling systems to include key components, functions, and maintenance required.			
Week 28 **Heat Pumps**	• How do heat pumps work? • Why might a heat pump be utilized? • How does a reversing valve work? • What types of heat pumps are in use? • What are the benefits and drawbacks of heat pumps?	• Articulate how heat pumps provide both heating and cooling. • Explain what applications and in what settings a heat pump would be effective. • Explain how a reversing valve works and how that technology is critical for heat pump use. • Identify different types of heat pumps (ground source and air source).	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2 **Pathway Standards** AC-DES 8	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4,8 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Compare and contrast air source and ground source heat pumps. • Summarize the benefits and drawbacks for use of heat pumps.			
Weeks 29-30 **Career Exploration**	• What careers are of interest? • What are typical daily tasks, routines and working environment for career of interest? • What skills and traits are needed for career of interest? • What questions do I have regarding a career in this field? • How can I develop my skills in this field? • Of what benefit is EPA Section 608 certification?	• Identify several careers available in HVAC. • Through research, interviews, and job shadowing, identify aspects of task, routines and work environment. • Identify key skills and traits required within this profession. • Develop and research questions regarding this field. • Evaluate and revise resume, employability profile, and professional portfolio. • Articulate what EPA Section 608 is and when and where this certification is required. • Demonstrate proficiency by passing Section 608 certification.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio • Career Interest Survey • Written Reflection • Section 608 Certification **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation Checklist	**Career Ready Practices** **CRP 1,5,7,10** **Cluster Standards** **AC 7** **Pathway Standards**	**ELA** 9-10 R 1 9-10 W 2,3,5,6,7 9-10 SL 1,3,4,6 9-10 L 1,2,3,4,6 **Literacy** 9-10 RST 1,2,4 9-10 WHST 2,3,4,5 **Math/Science**
Weeks 31-35 **Sheet Metal**	• How can there be a transition from square to round in working with sheet metal? • What is the purpose of triangulation when manipulating sheet metal? • Why is accuracy important? • What is offset development?	• Define triangulation. • List circumstances where triangulation is employed for layout of sheet metal. • Demonstrate setting up a layout using triangulation with accurate labeling and pattern. • Demonstrate how labeling and lines of symmetry assist in development. • Explain offset development. • Articulate when and why offset development would be used.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2,6,8 **Cluster Standards** AC 2 **Pathway Standards** AC-DES 8	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4,7 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● When might an offset development be beneficial? ● What is parallel line development? ● When can parallel line development be utilized? ● What is rolling offset? ● When might a rolling offset be used? ● How is the measurement for a rolling offset calculated?	● Explain how offset development may be preferred over use of brake and bend technique. ● Define parallel line development for sheet metal. ● Identify uses of parallel line development. ● Demonstrate layout using parallel layout. ● Demonstrate fabrication using parallel line development according to given criteria. ● Define rolling offset. ● Explain application of rolling offset. ● Demonstrate calculating measurement for a pipe requiring rolling offset. ● Demonstrate fabrication of an offset piece.			
Week 36 **Fresh Air Intake**	● Why is the fresh air intake system important ● How does the design impact function? ● How are air intake systems fabricated?	● Articulate the purpose of fresh air intake. ● Articulate how fresh air intake systems are designed. ● Design a fresh air intake system given a set of provided criteria. ● Apply sheet metal manipulation skills to design and create a fresh air intake system.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2 **Pathway Standards** AC-DES 8	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 37 **Auxiliary Views**	● What are auxiliary views on design plans or blueprints? ● What do auxiliary views show? ● How are auxiliary views used? ● How is an auxiliary view created?	● Define and give examples of auxiliary views. ● Articulate what additional information auxiliary views provide. ● Interpret an auxiliary view blueprint. ● Create an auxiliary view blueprint according to given criteria.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 6 **Pathway Standards**	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4,7 9-10 WHST 2 **Math/ Science**
Week 38 **Fasteners and Adhesives**	● What are common fasteners? ● What are specific applications for common fasteners? ● What are common adhesives? ● How are adhesives applied safely and effectively?	● Identify common fasteners. ● Match specific fastener to specific application(s). ● Demonstrate use of fasteners. ● Identify common adhesives. ● Identity use for adhesives. ● Identify safety protocols for adhesives. ● Demonstrate use of adhesives.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2 **Pathway Standards** AC-DES 8	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math/ Science**
Week 39 **Hangers and Supports**	● What are different pipe hangers? ● What are different supports for pipes and equipment? ● How is it determined what to use within a given situation?	● Identify different pipe hangers. ● Summarize when specific types of hangers are used. ● Identify varied supports for pipes. ● Determine what hanger, clamp or support to use within a specific situation or location.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2 **Pathway Standards** AC-DES 8	**ELA** 9-10 SL 1,2,4,6 9-10 L 1,4,6 **Literacy** 9-10 RST 1,4 9-10 WHST 2 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 40 **Reflection**	● How might goals need to be revised? ● How is learning and skill acquisition documented?	● Articulate goals, acquisition and revisions. ● Communication skills and knowledge through employability profile, resume and portfolio.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,4,10	**ELA** 9-10 W 3 9-10 SL 1,4,6 9-10 L 1,2,3,4,6
				Cluster Standards AC 7	**Literacy**
				Pathway Standards	**Math** **Science**

Syracuse City School District
Career and Technical Education Program
HVAC Level 3 Course Syllabus

Program Overview

The heating and air conditioning program is designed to provide students with a comprehensive knowledge of heating, ventilation, air-conditioning, and refrigeration systems including both residential and commercial applications. Mastering installation, troubleshooting, and maintenance practices are central to this program. Students will also explore emerging technologies, Environmental Protection Agency (EPA) requirements and regulations. energy conservation techniques, and systems with exempt and non-exempt refrigerants. Students will balance individual skill development with group development skills including collaboration, communication, critical thinking, creativity, problem solving, perseverance. Students will develop clear communication skills, both written and spoken and an awareness of issues around diversity, ethical business practices, and social responsibility. Students will also obtain, at minimum. certification in OSHA 10 safety protocols and EPA Section 608.

Course Description

The third year focuses on heating systems. Students apply technical skills for installation, maintenance and service for fossil fuel systems including hot air and hydronic systems. Alternative systems such as use of electric heat, heat pumps and harnessing emerging sources for heating and cooling are also included. Customer service and preparing service and job estimates are included as job skills in addition to the application of technical skills. Refining career goals and expanding opportunities for field and project based experiences are a focus.

Work-Based Learning

Throughout the program sequence, students will be connected with local and national professionals throughout their learning experiences especially as they complete project-based learning experiences. These professional connections may include interviews, field trips to local businesses, virtual field trips to other locations, presenting their learning and work samples to professionals, job shadowing and career coaching. It is expected that these experiences will lead to opportunities for direct job training and real-world experience in an internship experience prior to completion of the program. Students will create and maintain a portfolio of their experiences to document the development of their skills, including a professional resume.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the project that they are involved in. Some examples for this pathway include, but are not limited to:
    - Power tool safety
    - Laddering safety
    - OSHA 10 hour
    - EPA Section 608

- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

HVAC Level 1
HVAC Level 2

Course Objectives

Upon completion of this course students will know and be able to:

- Identify careers of interest in this industry.
- Research career treads in this industry.
- Demonstrate safety protocols and procedures.
- Demonstrate safe use of basic and power tools.
- Demonstrate communication skills key for customer service.
- Demonstrate simple welding techniques.
- Demonstrate manipulation of piping and tubing and fittings.
- Summarize the operation of forced air heating systems.
- Demonstrate service and maintenance for forced air systems.
- Summarize the operation of gas and oil systems.
- Demonstrate service and maintenance for gas and oil systems.
- Summarize the operation electric heating systems.
- Demonstrate service and maintenance for gas and oil systems.
- Demonstrate proficiency with wiring systems.
- Summarize heating with hydronic systems.
- Summarize alternative or emerging sources and systems for heating and cooling.
- Determine heat loss within a given set of criteria.
- Summarize operation of oil burners.
- Summarize functions of controls.
- Create an estimate for service or job.
- Demonstrate effective communication, team work, time management, problem solving, creativity and awareness of diversity.

Integrated High School Academics

N/A

Concurrent College Enrollment

TBD

Equipment and Supplies

- **School will provide:** All tools including technology, equipment and supplies to complete projects
- **Student will provide:** N/A

Textbook

TBD

Grading

10% Classwork assignments
10% Tests/quizzes
80% Projects and presentations, (rubric)

Additional Course Policies

Students are expected to:

- Meet all deadlines and be on time. Deadlines and being on time are a major part of being a professional.
- Produce their best work, including being prepared for presentations.
- Participate in class including contributing to discussions and critiquing their own and others' work, as well as diligently working on their own projects.
- Seek help when needed.
- Be attentive, ask questions if they do not understand something, and offer their opinions.
- Demonstrate responsible and safe use of all equipment.
- Use identified technology hardware and software for preparing and sharing all work.
- Give credit and use proper citations for all research and project ideas.

Course Calendar

Quarter	Units of Study
1	● Class Expectations and Policies ● Safety Review ● Career Exploration and Goal Setting ● Customer Service ● Review Safely Working with Power Tools ● Introduction to Welding ● Piping and Tubing
2	● Forced Air Furnace Types and Fuels ● Ventilation: Chimneys, Flues and Vents ● Ignition ● Gas/Oil Heating Systems ● Introduction to System Maintenance
3	● Electric Heating Systems ● Wiring ● Duct Systems ● Hydronic Heating: Boiler Systems and Service ● Emerging Sources and Systems
4	● Heat Loss ● Oil Burners ● Operating Controls ● Career Research ● Estimating ● Reflection

Syracuse City School District
Career and Technical Education Program
HVAC Scope and Sequence
Level 3

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1 **Class Expectations and Policies** **Safety Review**	• What are the expectations for students in the HVAC program? • What are key safety concepts?	• Develop classroom rules and establish relationships. • Demonstrate proper use and care of PPE and tools (hand and power). • Demonstrate in daily practice safety protocols such as identifying and mitigating potential hazards and unsafe practices.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1, 2	**ELA** 11-12 SL 1,6 11-12 L 1,6
				Cluster Standards AC 3	**Literacy** 11-12 RST 1,2 11-12 WHST 2
				Pathway Standards AC-CST 5	**Math/ Science**
Week 2 **Career Exploration and Goal Setting**	• What are different careers available in HVAC that are of interest? • What skills and traits contribute to success in this field? • How are skills and accomplishments documented? • What types of businesses hire for this field? • What is the typical career path for HVAC professionals? • What are student goals for career and learning outcomes?	• Identify several careers available in HVAC. • Name key aspects for HVAC careers. • Identify key skills and traits required within this profession. • Evaluate and revise resume, employability profile, and professional portfolio. • Identify local, regional, and national employers. • Name what education, certifications and experiential requirements are for a career within this field. • Identify personal goals for long-term career and short-term learning.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio • Career Interest Survey • Written Reflection **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,10	**ELA** 11-12 R 1 11-12 W 2,3,5,6,7 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC7	**Literacy** 11-12 RST 1,5,7 11-12 WHST 2,3,4,5
				Pathway Standards	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 3 **Customer Service**	• What constitutes good customer service? • Why is good communication important? • What makes communication effective?	• List attributes for good customer service. • Explain the importance of clear and concise communication. • Demonstrate asking questions for clarification, additional information or to check understanding. • Demonstrate responding to questions in clear and concise answers. • Demonstrate clear written communication.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,6,8,9	**ELA** 11-12 W 2 11-12 SL 1,4,5,6 11-12 L 1,2,3,6
				Cluster Standards AC 5	**Literacy** 11-12 RST 2 11-12 WHST 2,5
				Pathway Standards AC-DES 2	**Math/ Science**
Week 4 **Review Safely Working with Power Tools**	• What are additional power tools not yet experienced? • What are safety considerations for power tools? • What is appropriate and responsible use and care of tools?	• Identify power tools such as hydraulic shears, 3 foot roller, 18-gauge electric shears. • Articulate purpose and how each tool is used. • Demonstrate appropriate safety protocols for use of power tools. • Demonstrate responsible use and care for power tools.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 3	**Literacy** 11-12 RST 2 11-12 WHST 2
				Pathway Standards AC-CST5 AC-CST 9	**Math/ Science**
Weeks 5-8 **Introduction to Welding**	• What does welding accomplish? • What safety considerations need to be employed? • What materials are used in welding? • What tools are used? • What is basic a welding technique?	• Define welding. • Articulate safety procedures and protocols. • Identify common materials used in welding. • Identify basic tools for welding. • Identify basic welding techniques. • Demonstrate basic welding technique.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST5, 9	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 8-10 **Piping and Tubing**	● How is a torch used? ● What are safety considerations for use of a torch? ● What are specific handling conditions for acetylene gas? ● For what purpose is the torch used? ● How can a pipe be threaded and sealed? ● How can adhesives be used to join pipes and fittings? ● How are compression fittings utilized? ● What types of materials can be connected with flare fittings? ● How can soldering be used to connect tubing and fittings? ● How can tubing be connected with a swaged brazed joint and nitrogen? ● How can materials be bent?	● Articulate safety precautions for use with a torch. ● Summarize how to safely check pressure of acetylene gas, how to purge oxygen and acetylene gasses, orientation of gas cylinder, and how to extinguish a torch. ● Articulate uses for a torch. ● Demonstrate using a torch safely including setting up, lighting and shutting off torches. ● Demonstrate connecting pipe using a threaded joint. ● Identify adhesives that can be used with pipe fitting. ● Summarize steps to join a pipe with adhesive. ● Demonstrate connecting PVC, fittings and pipe using a cemented joint. ● Identify types of tubing to use with compression fittings. ● Demonstrate connecting tubing using a compression fitting. ● Demonstrate connecting tubing by using flare fittings and tools. ● Demonstrate connecting tubing and fittings using a soft solder joint. ● Demonstrate connecting tubing using low-pressure nitrogen brazing. ● Demonstrate shaping tubing using bending tools and	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2,6,8 **Cluster Standards** AC 3 **Pathway Standards** AC-CST 5, 9 AC-DES 8	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		running tubing with an offset and corner.			
Weeks 11-13 **Forced Air Furnace Types and Fuels**	● What are 3 basic types of forced air furnaces? ● How do the different types operate? ● How does combustion occur? ● Why is combustion testing done? ● What are common fossil fuels used for heating?	● Identity up-flow down-flow and horizontal furnaces. ● Describe how each type of furnace operates. ● Compare and contrast types of furnaces in terms of operation, cost and efficiency. ● Describe the process of combustion. ● Demonstrate combustion testing. ● Interpret results from a combustion test. ● Identify common fuels for furnaces. ● Compare and contrast fuels in regard to cost, efficiency, environmental issues.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** AC 2,3 **Pathway Standards** AC-CST 3,5,9	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2 **Math/ Science**
Week 14 **Ventilation: Chimneys, Flues and Vents**	● Why is ventilation necessary? ● How do chimneys, flues and vents work?	● Describe the purpose of ventilation. ● Identify different manners of ventilation. ● Compare and contrast chimneys, flues and vents.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards** **Pathway Standards** AC-CST 9	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2 **Math/ Science**
Week 15 **Ignition**	● What are types of ignition systems? ● How do they operate? ● Why is proving important for gas systems?	● Identify ignition systems such as standing pilot, intermittent pilot, direct spark ignition. ● Compare and contrast the three types of ignition methods.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes	**Career Ready Practices** CRP 2 **Cluster Standards**	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• What methods are used to prove flame?	• Explain why proving flame is necessary. • Interpret data from a flame sensor.	**Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist		11-12 WHST 2
				Pathway Standards AC-CST 9	**Math/ Science**
Weeks 16-18 **Gas/Oil Heating Systems**	• What is the function of a heat exchanger? • What is the function of gas valves? • What is the function of a manifold? • How do the parts integrate into a system? • How are current gas systems different from ones in the past? • What is a condensing variable speed furnace? • What are the venting requirements for newer furnaces? • How does the heat exchanger function? • How does the blower motor function? • What are the benefits and drawbacks of a high efficiency furnace?	• Explain the purpose of heat exchanger. • Explain the purpose of gas valve. • Identify parts of a gas valve. • Explain purpose of a manifold. • Explain how individual parts all work to create a system. • Compare and contrast operation and parts of older gas systems with current gas systems. • Articulate what a condensing variable speed furnace is and how it functions. • Name venting requirements for high efficiency furnaces. • Describe the operation of the heat exchanger. • Describe the operation of the blower motor. • Synthesize the benefits and costs (drawbacks) of installing, maintaining and running a high efficiency furnace.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,4,5,6,7,8	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2,3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 3,5,9 AC-DES 8	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 19-20 **Introduction to System Maintenance**	• How do parts form a system? • What are the wiring requirements? • What are common areas to troubleshoot? • How can an issue be diagnosed?	• Create a sketch demonstrating how parts interact to create a system. • Interpret a schematic detailing wiring requirements. • Name common areas of failure. • Demonstrate troubleshooting a gas or oil forced air operated heating system to diagnose an issue.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,8	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2,3	**Literacy** 11-12 RST 2,4 11-12 WHST 2,5
				Pathway Standards AC-CST 3,5,9 AC-MO 2,3,5,6	**Math** **Science**
Weeks 21-22 **Electric Heating Systems**	• How do electric heating systems function? • What are common areas to troubleshoot? • How can an issue be diagnosed? • What safety protocols need to be in place?	• Explain how electric heating systems function. • Name common areas of failure. • Demonstrate troubleshooting an electric operated heating system to diagnose an issue. • Demonstrate use of ground fault circuit interrupters. • Demonstrate application of switch safety. • Apply lock out tag out protocol.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2,3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 3,5,9 AC-MO 2,3,5,6	**Math/ Science**
Weeks 23-24 **Wiring**	• What types of wire are used for HVAC systems? • What purpose do colored wires serve? • What are the 3 different schematics to guide wiring? • What are differences in residential and commercial wiring?	• Identify types of wire used in HVAC applications. • Summarize colors and corresponding function. • Articulate how the use of color supports safe practices. • Compare and contrast line diagrams, ladder diagrams and installation diagrams. • Interpret a line diagram, ladder diagram, and installation diagram.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2,3,6	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 9	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Articulate differences in residential and commercial wiring for HVAC systems.			
Weeks 25-27 **Duct Systems**	● What needs to be considered in the design of ductwork? ● How is air loss prevented? ● How are ducts fabricated?	● Identify need for configurations, supply return and vent location given a set of criteria. ● Identify how the use of take-offs, and stackheads contribute to prevention of air loss. ● Name gauges and types of metals used in ductwork. ● Name methods of fabrication.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2 **Cluster Standards AC 2** **Pathway Standards** AC-DES 3	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2 **Math/ Science**
Weeks 28-32 **Hydronic Heating: Boiler Systems and Service** **Emerging Sources and Systems**	● What are the components in a boiler system? ● How does the design impact function? ● How is the system controlled? ● What are common areas to troubleshoot? ● How can an issue be diagnosed? ● What are examples of emerging sources for heating and cooling. ● What may be the impact on the industry as alternative systems are developed?	● Identify components and parts of a boiler system. ● Explain how a boiler system operates. ● Explain how a boiler system is controlled. ● Name common areas of failure. ● Demonstrate troubleshooting a boiler heating system to diagnose an issue. ● Describe alternative sources for heating and cooling. ● Describe how emerging systems work. ● Analyze the impact emerging systems may have on the industry and regulations.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,5,6,8 **Cluster Standards** AC 2,3 **Pathway Standards** AC 3,5,9	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2,5 **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 33 **Heat Loss**	• What impact does choice of building materials have on heat loss? • What is R value? • How is R value calculated? • What recommendations can be offered to decrease heat loss?	• Compare and contrast differing building materials and impact on heat loss. • Define R value. • Demonstrate calculation of R value. • Summarize information on improving systems to make recommendations for lower energy costs and improved comfort.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2,6,7	**ELA** 11-12 R 1,4 11-12 W 2 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 1,2	**Literacy** 11-12 RST 2,4 11-12 WHST 2,5
				Pathway Standards AC-DES 8	**Math/ Science**
Weeks 34-36 **Oil Burners**	• How do oil burners function? • What components are in an oil burner. • Why are oil burners not installed frequently in new construction? • How might a homeowner convert from an oil burner to an alternative system?	• Explain how oil burners operate. • Identify components and parts of an oil burner. • Explain current regulations and building practices regarding use of oil burners. • Explain the process and what would need to be done to convert a residence from oil burner to an alternative system.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,8	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2,3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 3,5,9 AC-DES 3	**Math/ Science**
Week 37 **Operating Controls**	• What is the function of transformers? • What is the function of thermostats? • What is the function of anticipators?	• Describe the function of transformers. • Describe the function of thermostats. • Describe the function of anticipators.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 2	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 9	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 38 **Career Research**	● What careers are of interest? ● How do my talents, skills and interests align with a career of interest? ● What are the education, training and certification requirements for a career of interest? ● What does a professional in this career do daily? ● What are future forecasts for this employability in this career?	● Identify a narrow list of careers of interest. ● Evaluate and articulate how personal interest, talents and skills align with career choice. ● Name education, training, and certification requirements for career choice. ● Describe daily responsibilities and tasks of this career. ● Summarize trends and future forecasts for employability.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Career Interest Survey ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation Checklist	**Career Ready Practices** CRP 1,3,4,7,10	**ELA** 11-12 R 1 11-12 W 2,3,5,6,7 11-12 SL1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 7	**Literacy** 11-12 RST 2,5,7, 11-12 WHST 2,3,4,5.6.7
				Pathway Standards	**Math/ Science**
Week 39 **Estimating**	● What is BTU? ● How is BTU calculated? ● How is a material list determined? ● How are costs for a service estimated?	● Define BTU. ● Demonstrate calculation of BTU given a set of criteria. ● Demonstrate creation of a material list for a given job. ● Demonstrate creation and communication of an estimate for a service.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,9	**ELA** 11-12 SL1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 2,5,6	**Literacy** 11-12 RST 2,4 11-12 WHST 2,5
				Pathway Standards AC-DES 2	**Math/ Science**
Week 40 **Reflection**	● How might goals need to be revised? ● How is learning and skill acquisition documented?	● Demonstrate proficiency by passing Section 608 certification (as needed). ● Articulate goals, accomplishments, and revisions. ● Communication skills and knowledge through	**Written** ● Self-Assessment ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects	**Career Ready Practices** CRP 1,4,10	**ELA** 11-12 W 3 11-12 SL1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 7	**Literacy** 11-12 WHST 3,4

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		employability profile, resume and portfolio.	• Teacher Observation Checklist	**Pathway Standards**	**Math/ Science**

Syracuse City School District
Career and Technical Education Program
HVAC Level 4 Course Syllabus

Program Overview

The heating and air conditioning program is designed to provide students with a comprehensive knowledge of heating, ventilation, air-conditioning, and refrigeration systems including both residential and commercial applications. Mastering installation, troubleshooting, and maintenance practices are central to for this program. Students will also explore emerging technologies, Environmental Protection Agency (EPA) requirements and regulations. energy conservation techniques, and systems with exempt and non-exempt refrigerants. Students will balance individual skill development with group development skills including collaboration, communication, critical thinking, creativity, problem solving, perseverance. Students will develop clear communication skills, both written and spoken and an awareness of issues around diversity, ethical business practices, and social responsibility. Completion of this sequence will prepare students for employment in a variety of heating, ventilation, air-conditioning, and refrigeration occupations. Students will also obtain, at minimum, certification in OSHA 10 safety protocols and EPA Section 608.

Course Description

This final year is a culmination of skills and theory from the previous years as students are expected to apply their learning to install, service and maintain systems. A key portion of this year, is completion of an internship or capstone project to demonstrate the range of their learning and skill. Planning for post-secondary experiences are incorporated. The role of licensing, insurance, union membership and other business practices are included.

Work-Based Learning

Throughout the program, students will be connected with local and national professionals throughout their learning experiences especially as they complete project-based learning experiences. These professional connections may include interviews, field trips to local businesses, virtual field trips to other locations, presenting their learning and work samples to professionals, job shadowing and career coaching. It is expected that these experiences will lead to opportunities for direct job training and real-world experience in an internship experience prior to completion of the program. Students will create and maintain a portfolio of their experiences to document the development of their skills, including a professional resume.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the project that they are involved in. Some examples for this pathway include, but are not limited to:
  - Power tool safety
  - Laddering safety
  - OSHA 10 hour
  - EPA Section 608

- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

HVAC Level 1
HVAC Level 2
HVAC Level 3

Course Objectives

Upon completion of this course students will know and be able to:

- Identify requirements for careers of interest in this industry.
- Research career opportunities in this industry.
- Demonstrate job seeking skills and approaches.
- Create a future vision for post- high school.
- Demonstrate safety protocols and procedures.
- Demonstrate safe use of basic and power tools.
- Demonstrate compliance with EPA Regulations with refrigerant recovery.
- Demonstrate communication skills key for customer service.
- Demonstrate service and maintenance for gas and oil systems.
- Demonstrate service and maintenance for electric and alternative heating systems
- Demonstrate service and maintenance for cooling systems.
- Summarize the evolution and future of refrigerants.
- Demonstrate installation of ductwork.
- Summarize licensing, insurance, and role of unions.
- Summarize emerging technologies.
- Demonstrate effective communication, team work, time management, problem solving, creativity and awareness of diversity.

Integrated High School Academics

N/A

Concurrent College Enrollment

TBD

Equipment and Supplies

- **School will provide:** All tools including technology, equipment and supplies to complete projects
- **Student will provide:** N/A

Textbook

TBD

Grading

10% Classwork assignments
10% Tests/quizzes
80% Projects and presentations, (rubric)

Additional Course Policies

Students are expected to:

- Meet all deadlines and be on time. Deadlines and being on time are a major part of being a professional.
- Produce their best work, including being prepared for presentations.
- Participate in class including contributing to discussions and critiquing their own and others' work, as well as diligently working on their own projects.
- Seek help when needed.
- Be attentive, ask questions if they do not understand something, and offer their opinions.
- Demonstrate responsible and safe use of all equipment.
- Use identified technology hardware and software for preparing and sharing all work.
- Give credit and use proper citations for all research and project ideas.

Course Calendar

Quarter	Units of Study
1	● Course Expectations ● Goal Setting and Career Exploration ● Communicating Safety Protocols ● Career Preparedness and Application ● Compliance with EPA and Local Regulations
2	● Refrigerant Recovery ● Customer Relations and Estimating ● Servicing and Maintaining Oil and Gas (Fossil Fuel) Systems ● Alternative Fuel Systems
3	● Serving and Maintaining Cooling Systems ● Evolution of Refrigerants ● Installation of Ductwork
4	● Capstone Project/Internship ● Role of Licensing, Insurance and Unions ● Emerging Technology ● Reflection

Syracuse City School District
Career and Technical Education Program
HVAC Scope and Sequence
Level 4

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 1-2 **Course Expectations** **Goal Setting and Career Exploration**	• What are the expectations for students in the Heating, Ventilation and Air Conditioning program? • What certification and training requirements are necessary for specific career pathways of individual interest? • What specific skills and attributes contribute to success in this field? • Where are there job opportunities in this field? • What are student goals for career and learning outcomes?	• Develop classroom rules and establish relationships. • Identify certifications and training to support a career in this field. • Demonstrate proficiency on any outstanding certifications (such as OSHA 10, EPA 608) • Demonstrate knowledge and skills to support technical and customer service needed for success in this field. • Identify local, regional and national employers. • Define short and long-term goals.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio • Career Interest Survey • Written Reflection **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,10 **Cluster Standards** AC 7 **Pathway Standards**	**ELA** 11-12 W 3,6,7 11-12 SL 1,4,6 11-12 L1,2,3,4,6 **Literacy** 11-12 RST 2,7 11-12 WHST 2,3,4,5, **Math/ Science**
Weeks 3-4 **Communicating Safety Protocols**	• What are safety protocols for: PPE, Fire, Lifting, Laddering, Electrical Hazards, Hand and Power Tools?	• Articulate and demonstrate safety protocols. • Explain the importance of safety protocols. • Demonstrate response to simulated accidents.	**Written** • Self-Assessment • Class Assignments • Professional Portfolio	**Career Ready Practices** CRP 1 **Cluster Standards** AC 3	**ELA** 11-12 SL 1,2,3,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● How do safety protocols protect individuals from harm? ● What needs to occur in an instance of an accident? ● How are reports filed? ● How are safety protocols communicated?	● Demonstrate application of appropriate first aid. ● Demonstrate accurate and timely reporting of incidents. ● Demonstrate in daily practice safety protocols such as identifying and mitigating potential hazards and unsafe practices. ● Explain to others (peers) common safety hazards, key protocols for safety and reporting guidelines.	● Career Interest Survey ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist		11-12 WHST 2,3,4,5,6,7
				Pathway Standards AC-CST 5,9	**Math/Science**
Weeks 5-7 **Career Preparedness and Application**	● How do I build a successful life after high school? ● What do I want my future to look like? ● What college or career am I interested in? ● How do I apply for college or a specific job position? ● What documents are needed for application for college or job position? ● What is financial stability and why is it important to have a real-life budget?	● Articulate a vision for 2,5,10 years in the future. ● Explain the job application process. ● Find job boards and postings related to their area of interest. ● Complete job positions applications as applicable. ● Interpret NYS and IRS tax tables. ● Request letters of recommendation. ● Demonstrate interviewing skills. ● Identify and research any post secondary education or training of interest. ● Understand financial obligations and opportunities for post-secondary education and training, including the FAFSA application process as applicable. ● Write a college essay for submission as applicable.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,4,10	**ELA** 11-12 R 1 11-12 W 2,3,5,6,7 11-12 SL 1,2,3,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 7	**Literacy** 11-12 RST 2,7 11-12 WHST 2,3,4,5,6,7
				Pathway Standards	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Demonstrate financial knowledge about after-school budgets, including rent, auto costs, food, etc. • Create a realistic budget that can be used post-high school.			
Week 8 **Compliance with EPA and Local Regulations**	• What is the purpose of EPA regulations? • How does ozone depletion and global warming affect regulations? • What are the EPA requirements for refrigerant handling and disposal? • What information needs to be recorded and for how long are records maintained? • Why is the EPA certification for handling refrigerants necessary?	• Connect HVAC procedures and EPA regulations. • Name impacts of ozone depletion and global warming. • Identify regulations affecting ozone depletion and global warming in regards to refrigerant handling. • Identify EPA recordkeeping requirements for refrigerant handling and disposal including length of time records need to be retained and what information needs to be recorded. • Obtain the EPA Section 608 certification if still needed	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,4,5,9	**ELA** 11-12 R 1,4 11-12 W2,5,6,7 11-12 SL 1,2,4,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 3,5,9 AC- MO 2,3,5,6	**Math/ Science**
Weeks 9-12 **Refrigerant Recovery**	• What are the evacuation requirements for small appliances? • What is a non-condensable gas? • How does the temperature and pressure chart (P/T chart) assist to detect non-condensables? • What indicates that there are non-condensables in the tank of refrigerant?	• Define what is considered a small appliance in relation to HVAC. • Define non condensable. • Name examples of non-condensables. • Name required vacuum levels for small appliances. • Determine the amount of refrigerant to be recovered. • Demonstrate detection of non-condensables using the gauge set and pressure temperature chart to identify the refrigerants and non-condensables.	**Written** • Self-Assessment • Class Assignments • Written Reflection • Tests/quizzes **Performance** • Class Presentation • Projects • Class Assignments • Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,4,5,9	**ELA** 11-12 R 1,4 11-12 W2,5,6,7 11-12 SL 1,2,4,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 3	**Literacy** 11-12 RST 2,4 11-12 WHST 2
				Pathway Standards AC-CST 3,5,9 AC- MO 2,3,5,6	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● How is refrigerant recovered with an inoperable compressor? ● What is the difference between temporary and permanent access valves? ● How does one distinguish the high side from the low side of the system? ● How can refrigerants be recovered with system-dependent (passive) and self-contained (active) recovery methods? ● What are the main differences between passive and active recovery? ● Under what conditions is system-dependent recovery used? ● How can the solderless access fitting be removed at the conclusion of service? ● Why should temporary valves be removed? ● What percentage of refrigerant can leak from comfort cooling appliances before repairs need to be made? ● What percentage of refrigerant can leak from commercial industrial	● Demonstrate procedures for checking the vacuum level and the amount of refrigerant recovered. ● Articulate the difference between temporary and permanent access valves. ● Identify how to distinguish the high side from the low side of a system. ● Demonstrate installation of both high and low side temporary access valves on small appliances to recover refrigerant. ● Compare and contrast system-dependent (passive) and self-contained (active) recovery methods. ● Identify how to select the best recovery method for the situation. ● Demonstrate using the proper equipment for the passive and active recovery methods and refrigerant storage. ● Demonstrate removal of temporary solderless valves and repairing the holes in the unit after the service is completed. ● Demonstrate how to locate the leak rates on HVACR equipment according to the type of equipment and amount of refrigerant in the equipment.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	process refrigeration before repairs need to be made? ● What should be done with equipment that cannot be repaired? ● What are high-pressure and low-pressure recovery techniques? ● How is it determined whether to employ a high-pressure or low-pressure recovery technique? ● What are the key differences between high-pressure and low-pressure recovery? ● How does the refrigeration cycle differ between high and low pressure? ● What are the components of high-pressure and low-pressure appliances? ● What are considerations for recovery equipment? ● What are key differences between refrigerants in industrial and residential applications?	● Articulate necessary steps to be taken dependent on the amount of leakage in a system. ● Summarize procedures for disposal of equipment according to regulations. ● Identify high-pressure and low-pressure recovery techniques and requirements and how to determine which method to use. ● Compare and contrast the refrigeration cycle and the state of the refrigerant in the components of the high- and low-pressure system. ● Identify the components of high-pressure and low-pressure appliances and state of refrigerant ● Identify pressure-temperature relationships of high-pressure and low-pressure refrigerants. ● Identify who certifies recovery equipment. ● Explain the frequency of filter changes on recovery equipment. ● Explain how to minimize the loss of oil from a refrigeration unit when recovering refrigerant. ● Articulate differences between refrigerants in industrial and residential equipment.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 13 **Customer Relations**	● What is the process to determine a general diagnosis? ● What are key considerations for customer relations?	● Interpret potential concerns and descriptions from a customer's (lay person) perspective. ● Demonstrate respectful and careful listening. ● Demonstrate asking key questions to determine source of complaint (electrical or mechanical). ● Demonstrate clear and concise estimates and explanations of service. ● Demonstrate respectful answering of customer questions and concerns.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,6,8,9 **Cluster Standards** AC 2,5,6 **Pathway Standards** AC-DES 2	**ELA** 11-12 W 2 11-12 SL 1,2,3,4,5,6 11-2 L 1,2,3,4,6 **Literacy** 11-12 RST 2,7 11-12 WHST 2,3,4,5 **Math Science**
Weeks 14-18 **Servicing and Maintaining Oil and Gas (Fossil Fuel) Systems**	● How are traditional systems ignited? ● How is furnace efficiency determined? ● What is preventative maintenance and why is it important? ● How are safety controls tested and why is it important? ● Why does knowing the sequence that components operate assist in troubleshooting ● How does an oil system operate? ● How are oil burning systems cleaned, tested and replaced? ● How is the primary air adjusted on the burner of an oil furnace?	● Describe process of ignition including burner, air, thermocouple, adjustment, spark and pilot ignitor. ● Analyze combustion by examination of carbon dioxide level, flue temperature, and smoke test to determine furnace efficiency. ● Explain what regular clearing and maintenance can prevent. ● Articulate optimal frequency of preventive maintenance. ● List what a cleaning and preventative maintenance typically includes. ● What accidents might testing safety controls prevent? ● Demonstrate how to test each type of safety control used on oil and gas furnaces. ● Articulate questions that might be asked to determine what	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,6,8 **Cluster Standards** AC 2,3 **Pathway Standards** AC-CST 3,5,9 AC-MO 2,3,5,6	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2,5, **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● What other key components of an oil furnace may need replacement? ● How does a gas system operate? ● How are gas systems cleaned, tested and replaced? ● How is gas pressure checked and adjusted? ● What are gas pressure settings for LP and natural gas? ● How are gas leaks found?	operational sequence is not working. ● Summarize operation and sequence of events in an oil burning furnace. ● Locate the adjustment for air. ● Demonstrate adjustment of air by using Bacharach test kit and carbon dioxide test following all safety procedures. ● Articulate when an oil burner (chassis and air tube) needs replacement. ● Articulate how to determine if the motor on the oil burner is not functioning. ● Demonstrate testing and adjusting pressure and vacuum on fuel pump (including supply-line filter). ● Demonstrate replacement of oil filter cartridge. ● Demonstrate replacement of oil burner, motor, burner nozzle, fuel oil pump and oil filter. ● Identify the basic sequence of operation including internal safety checks, ignition, blower operation for gas furnace. ● Identity tools, procedures and testing of burner nozzle. ● Demonstrate checking gas pressure levels for both natural and propane gas. ● Demonstrate varied leak detection methods to test for gas leaks.			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● How are key components replaced? ● How is replacement of gas valve determined? ● How can neutral gas components and propane components be changed out? ● What are some factors that affect conversion of natural gas to propane gas? ● How is technical reading different from literary reading? ● What information do manufacturer's specifications provide? ● Why is it important to follow manufacturer's specifications?	● Demonstrate replacement of the gas orifice and gas burner. ● Demonstrate testing, evaluating and replacing gas valves. ● Demonstrate use of a conversion kit to convert natural gas components to propane components including checking gas pressure switch, replace appropriate orifice and springs and adjusting the gas valve regulator. ● Name factors that impact conversation such as gas pressure differences and elevation. ● Demonstrate use of text structure to guide technical reading. ● Demonstrate accurate reading of technical manuals including manufacturer's specifications. ● Describe why following manufacturer's specifications is important for safety and efficiency.			
Weeks 19-20 **Alternative Fuel Systems**	● What are other heating systems? ● How do alternative systems deliver heat? ● What are the advantages and disadvantages of alternative heating systems? ● What are key components and how do they operate for each	● Describe alternative heating systems such as electric heat, heat pump, and hydronics (radiant) heating systems. ● Analyze which system might be preferred given location, costs, and other criteria. ● Identify element, sequencer, limit switch/control for electric heat and describe how they function.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,5,6,8, **Cluster Standards** AC 2 **Pathway Standards** AC-CST 3,5,9 AC-MO 2,3,5,6	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2,5, **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	alternative system? Why have heat pumps become more prevalent? ● How does air get into the hydronics system and what impact does it have? ● What calculation is used to determine optimal temperature rise? ● How can desired temperature rise be improved?	● Identify reversing value, defrost control for heat pump system and describe how they function. ● Explain the benefits of a heat pump system. ● Identity water or circulating pump isolation valve, expansion tank, zone valve, pressure-reducing valve for hydronics system and describe how they function. ● Demonstrate how to purge air from a hydronics system (e.g., radiators) by locating purge points, using water keys and purging expansion tank. ● Calculate cubic feet per minute (CFM), using the temperature-rise method (CFM = (volts x amps x 3.41) /1.08 x delta T (temperature rise). ● Apply CFM to analyze how to impact optimal temperature rise.			
Weeks 21-25 **Serving and Maintaining Cooling Systems**	● How are tools and instruments used to install, test and service cooling systems? ● How is temperature difference measured across a coil? ● What is the process for installing a condensing unit? ● How is an air handler unit installed?	● Demonstrate proper use and care of tools and instruments. (such as-schematic or wiring diagram, ammeter, capacitor tester, manometer, multimeter, ohmmeter, voltmeter, refrigerant leak detector, manifold gauge, refrigerant scale, micron gauge) ● Match instruments to function. ● Demonstrate accurate reading of tools and instruments. ● Demonstrate using a thermometer on both sides of a	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,6,8 **Cluster Standards** AC 2,3 **Pathway Standards** AC-CST3,5,9 AC-MO 2,3,5,6	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2,5, **Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● What are methods of charging the air-conditioning system? ● How and when should external components of a cooling system be serviced?	condenser to measure temperature difference. ● Articulate the importance of leveling the condensing unit on a pad following spatial specifications for condensing units. ● Compare and contrast different considerations between setting a condensing unit and a heat pump. ● Demonstrate setting and leveling the unit, connecting the control-wiring and line voltage and connecting the liquid and suction lines using proper procedures. ● Name criteria for the best location for installation of the air handler. ● Demonstrate installation of an air handler including wiring the control voltage and the line voltage connections and selecting the proper blower speeds. ● Demonstrate charging an air-conditioning system according to manufacturer specifications. ● Identify external components of a cooling system and criteria to service them. ● Demonstrate checking external components by using mechanical and electrical instruments, articulate a diagnosis based on troubleshooting methods, and			

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		checking for proper air flow around and above the unit.			
Weeks 26-27 **Evolution of Refrigerants**	● What is R-22? ● What is R-410A? ● What are the benefits of R-410? ● What are current refrigerants? ● What impact do changing regulations have on practice? ● What are the benefits of emerging refrigerants?	● Summarize use of R-22 and why it is not recommended or allowable. ● Summarize the development of R-410A including why it was developed, safety aspects, tools, and impact on environment. ● Describe the newer classification of refrigerants (A2L, R-32, R-454B). ● Describe the impact and considerations as different types of refrigerants are introduced. ● Articulate the benefits of these newer replacements.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** **CRP 1,2,4,5,7**	**ELA** 11-12 R 1 11-12 W 2,5,6,7 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards **AC 3**	**Literacy** 11-12 RST 2,4 11-12 WHST 2,5,6,7
				Pathway Standards	**Math/Science**
Weeks 28-30 **Installation of Ductwork**	● How can existing plenum be evaluated and modified for evaporator installation? ● What is the optimal shape and length for duct? ● How is a branch duct takeoff using round metal duct installed? ● How is a rectangle metal duct installed? ● How is round metal duct installed? ● What are considerations for installation of the main duct using rectangular rigid fiberglass and fittings.	● Evaluate location, size and seal of existing plenum. ● Determine sizing according to cubic feet per minute (CFM) capacity of the round duct. ● Demonstrate use of proper tools to install the branch duct takeoff from the main, using round metal duct and fittings. ● Demonstrate sizing, laying out, and installing a rectangular metal duct and fittings, using proper tools and following safety procedures. ● Demonstrate sizing and installing a round metal duct and fittings, using proper tools and following safety procedures.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 2,8	**ELA** 11-12 SL1,4,5,6 11-12 L 1,4,6
				Cluster Standards AC 2	**Literacy** 11-12 RST 2,4 11-12 WHST 2,5,
				Pathway Standards AC-CST 9 AC-DES 3,8	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● How is optimal air flow based on the size of the unit/equipment and the duct determined?	● Articulate the health risks of working with fiberglass in duct systems, and what safety precautions should be taken. ● Identify what tools are used to install fiberglass ductwork. ● Describe the steps of layout and installation of rigid fiberglass duct, tools and safety procedures. ● Apply use of manual calculation CFM and a ductulator to determine needed duct size. ● Determine optimal air flow using a sizing chart, calculating for size of equipment and load and calculating for type of duct and design.			
Weeks 31-35 **Capstone Project or Internship**	● What contributes to a successful business? ● How is customer service delivered? ● How are protocols and practices implemented in varied settings? ● How are national, state, and local regulations followed?	● Develop/analyze a concept for business related to HVAC. ● Develop/analyze a business plan to include financing, market plan and customer out-reach. ● Develop/analyze a mission statement. ● Develop/analyze web-based information to entice customers to engage.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,2,4,5,6,7,8,9,11,12 **Cluster Standards** AC 7	**ELA** 11-12 R 1 11-12 W 2,5,6,7 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6 **Literacy** 11-12 RST 2,4 11-12 WHST 2,3,4,5,6,7

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		● Summarize national, state and local regulations to establish and operate a business. ● Develop/summarize a prototype of the service offered. ● Develop/summarize follow-up customer care. ● Present concept of potential business and incorporate feedback from professionals in the industry into the business plan or present accomplishments and analysis of skills and experiences of internship. ● Evaluate the project/experience for what contributed towards success and what could be revised.		**Pathway Standards**	**Math/ Science**
Weeks 36-37 **Role of Licensing, Insurance and Unions**	● What type of license is required for this career? ● How is a license acquired? ● What types of insurance are required? ● How is insurance obtained? ● What are the costs of insurance? ● What organizations support employment in this field? ● What national and local unions are associated with this field? ● What are the benefits and drawbacks of union employment?	● Articulate licensing requirements nationally, state and locally. ● Identify requirements and where to obtain a license. ● Identify different types of required insurances. ● Identify where to obtain insurance. ● Research cost of types of liability, workmen's compensation and other insurances. ● Identify national, state and local employment networks, organization or applicable unions. ● Analyze benefits of unions.	**Written** ● Self-Assessment ● Class Assignments ● Written Reflection ● Tests/quizzes **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,3,10	**ELA** 11-12 R 1 11-12 W 2,5,6,7 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 3,5	**Literacy** 11-12 RST 2,4,7,8 11-12 WHST 2,5,6,7
				Pathway Standards	**Math/ Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	● What is the process for union membership?	● Explain process and requirements to obtain union membership.			
Weeks 38-39 **Emerging Technology**	● What are some technologies being explored that impact heating, ventilation, and air conditioning installation and practices?	● Summarize emerging technologies in the heating, ventilation, air conditioning and refrigeration. ● Summarize potential benefits of emerging technologies. ● Analyze potential impact on equipment, service, and practices. ● Predict a trend and how it may be implemented.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,4,5,6,7,11,12	**ELA** 11-12 R 1 11-12 W 2,5,6,7 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards	**Literacy** 11-12 RST 2,4,7,8 11-12 WHST 2,5,6,7
				Pathway Standards	**Math/ Science**
Week 40 **Reflection**	● What personal goals have been accomplished? ● How has personal vision evolved? ● How do current talents, skills, and accomplishments support vision and goals? ● How are accomplishments reflected on a resume, employability profile and professional portfolio?	● Articulate accomplishments and goals. ● Analyze previous learning goals to determine future learning needs. ● Evaluate personal accomplishments and goals. ● Refine and update resume, employability profile and professional portfolio. ● Complete any outstanding certifications.	**Written** ● Self-Assessment ● Class Assignments ● Professional Portfolio ● Written Reflection **Performance** ● Class Presentation ● Projects ● Class Assignments ● Teacher Observation/ Checklist	**Career Ready Practices** CRP 1,4,10	**ELA** 11-12 W 3 11-12 SL 1,4,5,6 11-12 L 1,2,3,4,6
				Cluster Standards AC 7	**Literacy** 11-12 WHST 3,4
				Pathway Standards	**Math/ Science**