

# HVAC SYSTEMS

## INDUSTRY SECTOR | Building and Construction PATHWAY | Mechanical Systems Installation and Repair

### COURSE ESSENTIAL QUESTION:

Will I learn how to control the environment for comfort?

### COURSE OVERVIEW:

Are you ready to learn skills for a high demand, high skill, high wages, rewarding technical career? Then this is for you. This course prepares students to install, operate, test, repair and maintain commercial and domestic heating and air-conditioning systems. Provides entry-level and upgraded training in Heating Ventilation, Air Conditioning, and Refrigeration (HVAC/R). Instruction covers technical math for air conditioning, HVAC/R fundamentals, HVAC/R installation practices, and EPA (Environmental Protection Agency) regulations related to HVAC. This class is designed for ROP high school student who will be given priority registration. Adult enrollment is contingent upon available space. Integrated throughout the course are Common Core State Standards and Career Technical Education Standards, which include safety, communication, technology, ethics, career planning and other employability skills. This course prepares students to articulate with Mt. sac HVAC program at the end of the course.

### INFORMATION:

- A. **Pre-requisite:** 16 years old or an 11<sup>th</sup>/12<sup>th</sup> grader
- B. **Abilities Required:** [Click here to enter text.](#)
- C. **Dress Requirement and Grooming:** Must dress code/Industry Standards
- D. **Students must master 75% of the certificate competencies to receive a certificate.**
- E. **Fee:** None
- F. **Course Length:** 180 hours
- G. **Textbook:** Modern Refrigeration 18<sup>th</sup> Edition - Althouse, Turnquist and Bracciano
- H. **UC a-g Approved:** No
- I. **Industry Certification:** No
- J. **Sequencing to Include a Capstone:** Yes
- K. **Community College Articulation:** Yes
- L. **Common Core Alignment:** Yes
- M. **Community Classroom:** No
- N. **Career Technical Student Organization:** No
- O. **Work-Based Learning:** No

IDEA/THEME: UNIT 2. FUNDAMENTAL CONCEPTS OF AIR CONDITIONING HUMAN COMFORT

ENGAGING TITLE:

ESSENTIAL QUESTION: What are the in's and Out's of trouble shooting air conditioners and heaters?

INSTRUCTIONAL HOURS: 20 hours

### Common Core Unit Objective

In this unit of instruction, the students will learn about system performance, troubleshooting skills, repairs for HVAC and the effects of temperature on human comfort.

### Key Assignments

- In groups of 5, students will complete a pressure temperature conversion written assessment and demonstrate using equipment based on scenario.

### Anchor Standards

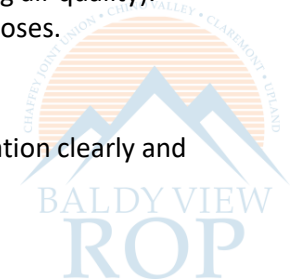
- 2.0 **Communications:** Acquire and accurately use Building and Construction Trades sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.
- 3.0 **Career Planning and Management:** Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.
- 3.4 Research the scope of career opportunities available and the requirements for education, training, certification and licensure.

### Pathway Standards

- C 1.0 Demonstrate an understanding of the methods and devices used to troubleshoot HVAC equipment.
- C 1.1 Explain the historical development and principals of air- conditioning and refrigeration.
- C 1.2 Describe the differences between air- conditioning and refrigeration on society.
- C 1.4 Explain the differences in comfort applications (cooling/heating) and process application (improving air quality).
- C 1.9 Identify various HVAC professional organizations, associations, and societies and explain their purposes.

### Common Core Standards

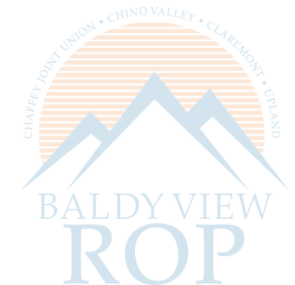
- WS 11-12.2 Write informative/explanatory texts to examine and recovery complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.



## RESOURCES:

### Resources

1. Text book – Modern Refrigeration
  - a) Chapter 1, page 1-31, page 36-55
  - b) Chapter 2, Tools and Materials, page 62-81
  - c) Chapter , page 90-93, page 98-99
  - d) Chapter 9, page 359, 361
  - e) Chapter 10, page
  - f) Chapter 12, page 434-449,
  - g) Chapter 15, page 583, 585
2. YouTube video – “Principals of Refrigeration”, <https://www.youtube.com/watch.mtsac.articulationAR20exammaterial>



**IDEA/THEME: UNIT 3. FUNDAMENTAL CONCEPTS OF REFRIGERATION**

**ENGAGING TITLE:**

**ESSENTIAL QUESTION: Can I make things hot or cold?**

**INSTRUCTIONAL HOURS: 35 hours**

**Common Core Unit Objective**

In this unit of instruction, the students will learn about the principles of **the** basic refrigeration compression cycle and heat transfer.

**Key Assignments**

- Removal of a condenser unit: cycling down system isolating refrigerant and cutting piping, vacuum system and recharge system.

**Anchor Standards**

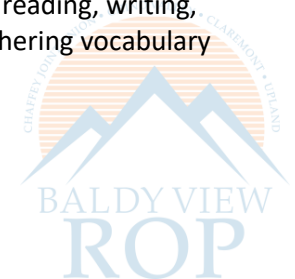
- 5.0 **Problem Solving and Critical Thinking:** Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Building and Construction Trades sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques. (Direct alignment with WS 11-17.7)
- 5.1 Identify and ask significant questions that clarify various points of view to solve problems.
- 5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

**Pathway Standards**

- C 2.0 Describe the basic components and concepts of heating, air-conditioning, and refrigeration.
- C 3.0 Demonstrate an understanding of the scientific theories and physical properties of heat and matter.
- C 4.0 Analyze the effects and reactions of fluids, pressures, and temperatures on refrigerants.

**Common Core Standards**

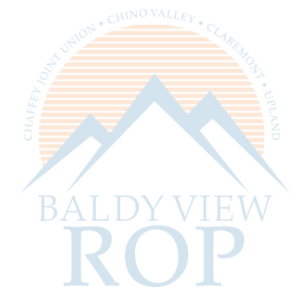
- LS 11-12.6 Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression



## RESOURCES:

### Resources

1. Mt. Sac Articulation Written Charts and Data Collection
2. Textbook - Modern Refrigeration
  - a) Chapter 9, Refrigerants, page 359, Pressure/temperature chart
  - b) Chapter 12, Servicing and installing small hermetic systems, page 434-435
3. YouTube Video: From Ritchie Engineering – Modern Refrigeration



IDEA/THEME: UNIT 1. BASIC SHOP PRACTICES, TOOLS AND SAFETY

ENGAGING TITLE:

ESSENTIAL QUESTION: Do I know what tools I need to complete a job?

INSTRUCTIONAL HOURS: 25 hours

### Common Core Unit Objective

In this unit of instruction, students will study basic tools and materials utilized in the HVAC/R industry to complete repairs and installations.

### Key Assignments

- Inventory, identification, and use of tools of the HVAC trade included in student's assigned toolboxes.

### Anchor Standards

- 10.0 **Technical Knowledge and Skills:** Apply essential technical knowledge and skills common to all pathways in the Building and construction Trades sector, following procedures when carrying out experiments or performing technical tasks.

### Pathway Standards

- C 5.0 Demonstrate skills necessary to fabricate and service the tubing, piping, and fittings utilized in accordance with accepted industry standards.

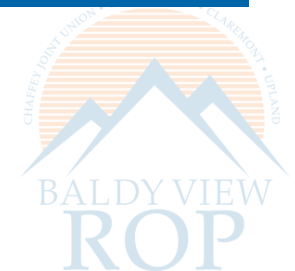
### Common Core Standards

- SEP-CC .3 Scale, proportion, and quantity.

## RESOURCES:

### Resources

1. Refrigeration Tools and Material, chapter 2, page 61-100
2. YouTube videos



IDEA/THEME: UNIT 4. PREVENTATIVE MAINTENANCE

ENGAGING TITLE:

ESSENTIAL QUESTION: How can I prolong the life of an Air Conditioner?

INSTRUCTIONAL HOURS: 25 hours

**Common Core Unit Objective**

In this unit of instruction, the students will learn how to evaluate HVAC/R systems and perform preventative equipment maintenance.

**Key Assignments**

- Cleaning a condenser coil and evaporator coil, and recording fan operation.

**Anchor Standards**

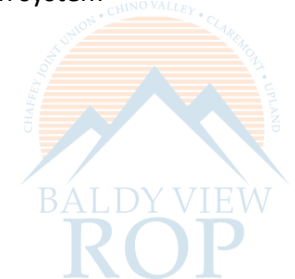
- 6.0 **Health and Safety:** Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Building and Construction Trades sector workplace environment.
- 10.0 **Technical Knowledge and Skills:** Apply essential technical knowledge and skills common to all pathways in the Building and construction Trades sector, following procedures when carrying out experiments or performing technical tasks.
- 11.0 **Demonstration and Application:** Demonstrate and apply the knowledge and skills contained in the Building and Construction Trades anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.
- 11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Building and Construction Trades sector program of study.

**Pathway Standards**

- C 6.0 Demonstrate the skills necessary to service, maintain, and repair heating, air-conditioning, and refrigeration system components and accessories.

**Common Core Standards**

- PS3.A Definitions of Superheat, Sub cool, and P/T Chart.  
PS3.B Conservation of Energy and Energy Transfer



## RESOURCES:

### Resources

1. YouTube – [http://youtu.be/x\\_zdanDygRA](http://youtu.be/x_zdanDygRA)
2. YouTube – [http://youtu.be/vg4Mc\\_TCsgw](http://youtu.be/vg4Mc_TCsgw)
3. YouTube – <http://youtu.be/x4bAYu1e1rE>





IDEA/THEME: UNIT 5. FUNDAMENTALS OF BASIC ELECTRICITY

ENGAGING TITLE:

ESSENTIAL QUESTION: Do I have Power?

INSTRUCTIONAL HOURS: 30 hours

### Common Core Unit Objective

In this unit of study, students will learn and apply Ohm's law and the principles of electrical theory by proper use of electrical instruments.

### Key Assignments

- Testing compressor motor winding and identify electrical loads.
- Determine circuits and solve problems utilizing meters and Ohni's Law.

### Anchor Standards

- 6.0 **Health and Safety:** Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Building and Construction Trades sector workplace environment
- 11.0 **Demonstration and Application:** Demonstrate and apply the knowledge and skills contained in the Building and Construction Trades anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.
- 11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Building and Construction Trades sector program of study.

### Pathway Standards

- C7.0 Demonstrate a practical knowledge of basic electricity and skills necessary to service and maintain the electrical components of heating, air-conditioning, and refrigeration equipment.
- C 7.2 Compare and contrast single-phase versus three-phase electrical distribution.
- C 7.3 Define and distinguish amps, ohms, volts, and watts.
- C 7.4 Demonstrate the ways to measure watts, voltage, amperage, and resistance using appropriate instruments while adhering to industry standards.



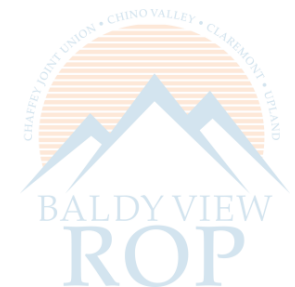
### Common Core Standards

- PS3.A Definitions of Energy
- PS3.B Conservation of Energy and Energy Transfer

### RESOURCES:

#### Resources

1. [http://youtu.be/aWPwWIPZj\\_M](http://youtu.be/aWPwWIPZj_M)
2. <http://youtu.be/fxwFzhaZmgY>
3. <http://youtu.be/HTONYufndwM>



IDEA/THEME: UNIT 6. APPLYING CONCEPTS OF BASIC ELECTRICITY

ENGAGING TITLE:

ESSENTIAL QUESTION: How to fix my broken AC?

INSTRUCTIONAL HOURS: 25 hours

### Common Core Unit Objective

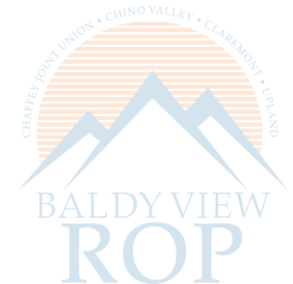
In this unit of instruction, students will practice and demonstrate proper use of testing electrical instruments.

### Key Assignments

- Determine circuits and solve problems utilizing meters and Ohm's law.

### Anchor Standards

- 6.0 **Health and Safety:** Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Building and Construction Trades sector workplace environment.
- 11.0 **Demonstration and Application:** Demonstrate and apply the knowledge and skills contained in the Building and Construction Trades anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.
- 11.1 Utilize work-based/workplace learning experiences to demonstrate and expand upon knowledge and skills gained during classroom instruction and laboratory practices specific to the Building and Construction Trades sector program of study.



### Pathway Standards

- C7.0 Demonstrate a practical knowledge of basic electricity and skills necessary to service and maintain the electrical components of heating, air-conditioning, and refrigeration equipment.
  - C7.5 Illustrate and summarize a wiring schematic diagram for a heating or cooling system.
  - C7.6 Analyze and troubleshoot the protection devices, such as fuses and breakers, in an electrical system.
  - C7.7 Interpret charts and tables from the National Electrical Codes (NEC).
- C8.0 Troubleshoot electrical control systems, motors, and their components.
  - C8.6 Demonstrate the ability to wire a basic heating, air-conditioning, and/or refrigeration system.
  - C8.10 Assess an electric motor for proper function and repair as necessary.
- C9.0 Demonstrate a practical knowledge of solid-state electronics.
- C10.0 Demonstrate a practical knowledge of combustion heating systems.

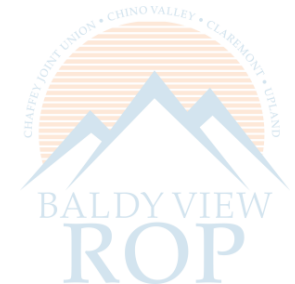
### Common Core Standards

- SEP.1 Asking questions (for science) and defining problems (for engineering)
- SEP.2 Developing and using models
- SEP.3 Planning and carrying out investigations
- SEP.4 Analyzing and interpreting data

### RESOURCES:

#### Resources

1. <http://youtu.be/AE5zRWtlhAA>
2. <http://youtu.be/KdFIARakavk>
3. <http://youtu.be/DmFsQbowYlg>



**IDEA/THEME: UNIT 7. TROUBLESHOOTING**

**ENGAGING TITLE:**

**ESSENTIAL QUESTION: How do I fix the right component?**

**INSTRUCTIONAL HOURS: 15 hours**

**Common Core Unit Objective**

In this unit of instruction, students will demonstrate the ability to identify issues with systems failures.

**Key Assignments**

- Identify incorrect operation of HVAC equipment, compressor failures, and correcting necessary problems.

**Anchor Standards**

- 11.0 **Demonstration and Application**- Demonstrate and apply the knowledge and skills contained in the Building and Construction Trades anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the Skills USA career technical student organizations.

**Pathway Standards**

- C8.0 Troubleshoot electrical control systems, motors, and their components.
- C8.1 Identify and explain the operations of electrical control systems and their components.
  - C8.2 Install and troubleshoot electrical control systems.
  - C8.3 Describe the operation and function of different types of electromechanical thermostats.
  - C8.4 Analyze operational problems with different types of electromechanical thermostats.
  - C8.5 Describe the electrical and mechanical operations of a basic heat pump.
  - C8.8 Describe the differences between single-phase and three-phase motors.

**Common Core Standards**

- SEP.1 Asking questions (for science) and defining problems (for engineering)
- SEP.2 Developing and using models
- SEP.3 Planning and carrying out investigations
- SEP.4 Analyzing and interpreting data
- SEP.5 Using mathematics and computational thinking



## RESOURCES:

### Resources

1. Classroom experience
2. Instructor demonstration with use of tools.
3. Student Personal Experience
4. [http://youtu.be/TL4v5DY\\_4\\_0](http://youtu.be/TL4v5DY_4_0)

