

Curriculum: HVAC I & II

Curricular Unit: General Shop Safety

Instructional Unit: A. Identify and apply all personal and work place safety procedures

Standard Alignments (Section 2)

HEGLE: HME.4.A
Knowledge: (H/PE) 6,7
CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4
NETS: 1c
Performance: 3.1, 4.7

Unit (Section 3)

Learning Targets:

- Demonstrate appropriate workplace safety practices (e.g., combustibles, electrical, hand tools, power tools, lockout/tag out, fall protection, refrigerants and pressurized gases)
- Identify types, purposes, and operation of fire extinguishers and suppression systems
- Inspect shop/lab for hazards
- Recognize when first aid is needed for occupational injuries and follow proper procedures
- Demonstrate victim removal procedures from an electrical conductor
- Apply MSDS (Material Safety Data Sheet) information to material use
- Adhere to applicable local, state, and federal regulations (EPA [environmental], DOT [moving vehicle] and OSHA [worker safety])

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions:
 - participate effectively in a range of collaborative discussions
 - differentiate between life threatening and non-life threatening injuries and select the appropriate level of treatment
 - Student note taking: The students summarize and organize information in a note-taking activity
- Student activity (Textbook Unit 4: General Safety Practices): Read Unit 4 and determine the central idea of the text

<ul style="list-style-type: none"> • The teacher will model/demonstrate proper safety procedures of HVAC tools and equipment, such as: <ul style="list-style-type: none"> • hand tools • fire extinguishers • refrigerants • pressurized gases • Students will model/demonstrate all proper safety procedures
<p>Assessments/Evaluations:</p> <ul style="list-style-type: none"> • Formative: Written assignment: “Unit 4: review questions” on page 82 • Summative: <ul style="list-style-type: none"> • IML Safety Test evaluated using a scoring guide • Safety competencies are assessed in all summative projects included in the course • Student demonstration of proper safety procedures • Techniques introduced in the unit are observed and monitored every day with each activity
<p>Sample Assessment Questions:</p> <ul style="list-style-type: none"> • What can happen when oil is mixed with oxygen under pressure? <i>A violent explosion can occur.</i>
<p>Instructional Resources/Tools:</p> <ul style="list-style-type: none"> • Textbook and Workbook: “<i>Refrigeration & Air Conditioning Technology</i>” by Whitman and Johnson, Delmar Cengage Learning © 2009 • Whiteboard: Used as a: <ul style="list-style-type: none"> • projector board for splashboard and air-server • drawing board • Safety equipment, such as: <ul style="list-style-type: none"> • safety glasses • shop wear • Media equipment: <ul style="list-style-type: none"> • Newspaper/HVAC magazines • iPad
<p>Cross Curricular Connections:</p> <ul style="list-style-type: none"> • ELA: <ul style="list-style-type: none"> • Technical reading • Writing • Discussion

Depth of Knowledge (Section 5)

DOK: 2

Curriculum: HVAC I & II

Curricular Unit: Refrigeration Principles

Instructional Unit: B. Identify and apply refrigeration principles and practices consistent with industry standards

Standard Alignments (Section 2)

HEGLE: EHMP.2.A

SCCLE: SC7.1.Ba-d (Physical Science)

Knowledge: (CA) 1,3,6 (MA) 1,2 (SC) 1,2

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.3, G-CO.12;

G-MG.1; G-MG .3; G-GMD.4

NETS: 1c; 4b

Performance: 1.5, 3.1, 3.2

Unit (Section 3)

Learning Targets:

- **Read and interpret pressure temperature charts**
- **Explain principles of refrigeration and heat transfer theory**
- Identify refrigerants/oil types and their characteristics and uses
- **Operate a gauge manifold set**
- Leak-test system
- Evacuate and measure vacuum level to 500 microns
- Recover and recycle refrigerants
- **Charge system to manufacturer's specifications**
- Describe the operation of refrigeration system accessories (e.g., receivers, accumulators, filter/dryer, sight glasses, valves)

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions: participate effectively in a range of collaborative discussions
 - Student note taking: The students summarize and organize information in a note taking activity

<ul style="list-style-type: none"> • Student’s activity (Textbook Chapters 8-10: <u>Principles of Refrigeration</u>; Textbook Chapter 15: <u>Charge System to Specification</u>): <ul style="list-style-type: none"> • Read Chapters 8-10, 15: Determine the central idea of the text • Demonstrate and explain all unit procedures • Students will model/demonstrate all proper safety procedures
<p>Assessments/Evaluations:</p> <ul style="list-style-type: none"> • Formative: <ul style="list-style-type: none"> • Written assignment: Chapters 8-10, 15 “Test Your Knowledge” questions • Workbook activities: Chapters 8-10, 15 • Formative/summative: Assessed using a teacher-created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks: <ul style="list-style-type: none"> • Leak test an air conditioning system • Evacuate an air conditioning system • Recover and recycle refrigerants • Determine superheat and sub-cool readings using temperature/pressure charts • Use of Gauge Manifold set
<p>Sample Assessment Questions:</p> <ul style="list-style-type: none"> • If the temperature of refrigerant R-134a is 10°F, what is the refrigerant pressure? <i>11.9 psig.</i>
<p>Instructional Resources/Tools:</p> <ul style="list-style-type: none"> • Textbook and Workbook: “<i>Refrigeration & Air Conditioning Technology</i>” by Whitman and Johnson, Delmar Cengage Learning © 2009 • Textbook and Workbook: “<i>Heating and Cooling Essentials</i>” by Killinger, Goodheart-Wilcox, Co, Inc. © 1999 • Whiteboard: Used as a: <ul style="list-style-type: none"> • projector board for splashboard and air-server • drawing board • Safety equipment, such as: <ul style="list-style-type: none"> • safety glasses • shop wear • Shop equipment/tools, such as: <ul style="list-style-type: none"> • gauge manifold • vacuum pump • Media equipment: <ul style="list-style-type: none"> • Newspaper/HVAC magazines • iPad

Cross Curricular Connections:

- Math:
 - Number sense
 - Geometric design
 - Working with formulas
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: HVAC I

Curricular Unit: Piping Principles and Practices

Instructional Unit: C. Identify and apply piping principles and practices

Standard Alignments (Section 2)

Knowledge: (CA) 3 (MA) 1,2,5 CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.3; S-ID.9 NETS: 4b Performance: 1.10, 2.5, 3.2, 4.1

Unit (Section 3)

Learning Targets:

- Identify tubing and fitting types
- **Perform copper tubing operations (e.g., cutting, flaring, soldering, brazing, bending, and swaging)**
- Install and replace PVC tubing and pipe
- Perform/construct gas pipe and operations (e.g., cutting, reaming, threading, and connecting)

Instructional Strategies:

- After teacher-led demonstrations of proper procedures, students will demonstrate:
 - brazing
 - soldering
 - gluing
 - identifying types of tubing and their uses
 - gas pipe fabrication

Assessments/Evaluations:

- District/teacher created (for chapters 3-6 using Goodheart-Wilcox as a guide):
 - Tests (summative) – assessed using a teacher created scoring guide
 - Homework (formative)
- Students will have multiple formative projects preparing them for the summative:
 - PVC
 - Copper square brazing/soldering
 - Steel to copper brazing
 - Copper square braze/solder/flare

Sample Assessment Questions:

- Wrought fittings are preferred over mechanical-type fittings because they ____.
- A. are less likely to leak
- B. require less time to assemble
- C. can be used on hard or soft copper
- D. All the above**

Instructional Resources/Tools:

- Textbook and Workbook: “*Heating and Cooling Essentials*” by Killinger, Goodheart-Wilcox, Co, Inc. © 1999 (Chapters 3-6)
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools, such as:
 - tubing cutters
 - hacksaw
 - swaging tool
 - flaring tool
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- Math:
 - Number sense
 - Causation
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: HVAC I & II

Curricular Unit: Electricity

Instructional Unit: D. Apply basic electrical theory to construct circuits and solve electrical circuit problems

Standard Alignments (Section 2)

SCCLE: SC1.1.Ec (Physical Science)

Knowledge: (CA) 3 (MA) 1,2 (SC) 1

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; N-Q.3;
A-CED.4

NETS: 6c

Performance: 1.5, 2.5, 3.2, 4.1

Unit (Section 3)

Learning Targets:

- Apply the principles of alternating and direct current
- Differentiate between common single and three phase voltage systems (e.g., 240V, 60Hz, single phase; 208V, 60Hz, three-phase; 240V, 60Hz, three-phase; and 480V, 60Hz, three phase systems)
- Read and interpret voltage, ampere, ohm, and watt meters
- **Read and interpret electrical schematic and wiring diagrams**
- Install electrical power and control circuits
- Apply the Ohm's law principles as related to series, parallel, and series parallel circuits
- Apply the principles of electrical circuit protection (e.g., fuses, circuit breakers, disconnect switches, and grounds)

Instructional Strategies:

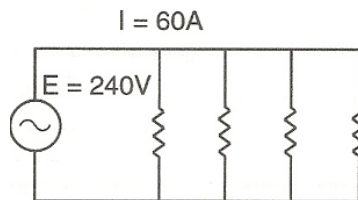
- Content is introduced with a teacher-guided lecture-discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student activity (Textbook Chapters 1-7: IML Basic Electricity)
 - Read Chapters 1-7: Determine the central idea of the text
 - Demonstrate and explain all unit procedures
- Students will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative/summative: Assessed using a teacher created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks:
 - Wiring projects 1-48 in the IML textbook
 - Wire simulated house walls for their house project
 - Re-wire the tool cage
 - Wire relays, contactors, thermostats, motors, etc.
 - Wire a simulated furnace/air-conditioner troubleshooting board
 - Re-wire furnace/air-conditioner with a wiring diagram

Sample Assessment Questions:

- Find the power:



$240 \times 60 = 14,400 \text{ watts}$

Instructional Resources/Tools:

- Textbook/workbook Chapters 1-7: IML Basic Electricity
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools – hand tools such as:
 - screwdrivers
 - wire strippers
- Teacher created diagrams
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- Math:
 - Number sense
 - Working with formulas
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: HVAC I & II

Curricular Unit: Electrical Motor Principles

Instructional Unit: E. Identify and apply electric motor principles and practices consistent with industry standards

Standard Alignments (Section 2)

SCCLE: SC1.Ec (Physical Science)

Knowledge: (CA) 3 (MA) 5 (SC) 1,2

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; N-Q.3;
A-CED.4; S-ID.9

NETS: 6c

Performance: 1.5, 1.10, 2.5, 3.5, 4.1, 4.7

Unit (Section 3)

Learning Targets:

- Apply the operating principles of electric motors
- Recognize the application of various types of electric motors
- Recognize the application of various types of capacitors
- Test capacitors
- Explain the principles and operation of electric motor protective devices
- Interpret electric motor specifications (e.g., horsepower and voltage)
- **Install and connect electric motors**

Instructional Strategies:

- Content is introduced with a teacher-guided lecture-discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student activity (Textbook Chapters 8-13: IML – Introduction to Electric Motors)
 - Read Chapters 8-13: Determine the central idea of the text
 - Demonstrate and explain all unit procedures
- Students will:
 - model/demonstrate all proper safety procedures
 - demonstrate mastery through installation and removal of motors

<p>Assessments/Evaluations:</p> <ul style="list-style-type: none"> Formative/summative assessments using a teacher created scoring guide – Students will have multiple formative projects preparing them for the summative on each of the following tasks: <ul style="list-style-type: none"> Unassembling and re-assembling a motor Installing a motor on a furnace/air-conditioner Checking motor bearings/amp readings to determine replacement
<p>Sample Assessment Questions:</p> <ul style="list-style-type: none"> A motor fails to start and an open circuit breaker was found. State the necessary remedies and checks: <i>Bad start relay, start capacitor, motor bearings, or low voltage.</i>
<p>Instructional Resources/Tools:</p> <ul style="list-style-type: none"> Textbook/workbook Chapters 8-13: IML <u>Introduction to Electric Motors</u> Whiteboard: Used as a: <ul style="list-style-type: none"> projector board for splashboard and air-server drawing board Safety equipment, such as: <ul style="list-style-type: none"> safety glasses shop wear Shop equipment/tools, such as: <ul style="list-style-type: none"> hand tools such as a screwdriver wire strippers meters Teacher generated diagrams Media equipment: <ul style="list-style-type: none"> Newspaper/HVAC magazines iPad
<p>Cross Curricular Connections:</p> <ul style="list-style-type: none"> Math: <ul style="list-style-type: none"> Number sense Working with formulas Determining causation ELA: <ul style="list-style-type: none"> Technical reading Writing Discussion

Depth of Knowledge (Section 5)

DOK: 4

Curriculum: HVAC I and II

Curricular Unit: Control Systems

Instructional: F. Apply principles of control systems consistent with industry and safety standards

Standard Alignments (Section 2)

SCCLE: SC2.2.C (Physics I)
Knowledge: (CA) 3 (MA) 1 (SC) 1,2
CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; N-Q.3; S-ID.9
NETS: 6c
Performance: 1.10, 3.3, 2.5

Unit (Section 3)

Learning Targets:

- **Apply the principles of safety devices and operating control circuits (e.g., pressure switches and thermostats)**
- Apply the principles of electro-mechanical control devices (e.g., relays, contactors, magnetic starters, timers, and sequences)
- Apply the principles of electronic control devices (e.g., ignition modules and electronic timers)
- Install/service electromechanical control devices
- Install/replace transformers

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student activity (IML Textbook Chapters 14-15: ACR Electrical Circuits)
 - Read Chapters 14-15: Determine the central idea of the text
 - Demonstrate and explain all unit procedures
- Students will model/demonstrate all proper safety procedures

<p>Assessments/Evaluations:</p> <ul style="list-style-type: none"> Formative/summative assessments using a teacher created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks: <ul style="list-style-type: none"> Creating a troubleshooting board simulating furnace/air-conditioner Troubleshooting electrical problems on furnaces/air-conditioners Diagramming proper wiring for multiple furnaces/air-conditioners Applying the correct wiring diagram to a real furnace/air-conditioner
<p>Sample Assessment Questions:</p> <ul style="list-style-type: none"> A customer complains of no cooling. Upon arrival at the location, you observe both fans running, but the compressor is not running. Assuming there are no broken wires, what components could cause the problem? <i>Bad start relay, start capacitor, mechanically defective compressor, or bad contactor.</i>
<p>Instructional Resources/Tools:</p> <ul style="list-style-type: none"> Textbook/workbook IML Chapters 14-15: <u>ACR Electrical Circuits</u> Whiteboard: Used as a: <ul style="list-style-type: none"> projector board for splashboard and air-server drawing board Safety equipment, such as: <ul style="list-style-type: none"> safety glasses shop wear Shop equipment/tools, such as: <ul style="list-style-type: none"> hand tools such as a screwdriver wire strippers volt/ohmmeter Teacher created diagrams Media equipment: <ul style="list-style-type: none"> Newspaper/HVAC magazines iPad
<p>Cross Curricular Connections:</p> <ul style="list-style-type: none"> Math: <ul style="list-style-type: none"> Number sense Causation ELA: <ul style="list-style-type: none"> Technical reading Writing Discussion

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: HVAC II

Curricular Unit: Heating and Cooling Installation and Repair

Instructional Unit: G. Install and repair residential/light commercial cooling and heating systems consistent with industry and safety standards

Standard Alignments (Section 2)

SCCLE: SC1.2.Ag (Physics I)

Knowledge: (CA) 3,6 (MA) 2 (SC) 7

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; N-Q.3;
A-CED.4; G-MG.3

NETS: 4b

Performance: 1.5, 3.8, 1.10

Unit (Section 3)

Learning Targets:

- Install or replace compressor
- **Install or replace condensing unit**
- Repair or replace condenser
- Repair or replace evaporator
- Replace, repair, and adjust metering devices
- Describe operation of a heat pump
- Describe zoned heating and cooling systems
- Start and check residential heating and cooling systems
- Measure and adjust conditioned air flow
- Describe vacuum pump and micron gauge applications
- **Pump down unit**

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student activity (Whitman Textbook Chapter 38: Installation)
 - Read Chapters 38: Determine the central idea of the text
 - Demonstrate and explain all unit procedures
 - Student will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative:
 - Chapter 38:
 - Written assignment: Review questions
 - Workbook activities
- Formative/summative assessments using a teacher-created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks:
 - Coil repair
 - Pump-down
 - Installing condensing unit and furnace
 - Replacing a compressor, condenser, evaporator, and metering device

Sample Assessment Questions:

- When insulation on the inside of the duct comes loose, it causes:
 - A. The system to shut off
 - B. High head pressure
 - C. Increased airflow
 - D. Reduced airflow**

Instructional Resources/Tools:

- Textbook and Workbook: “*Refrigeration & Air Conditioning Technology*” by Whitman and Johnson, Delmar Cengage Learning © 2009, Chapter 38
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools, such as:
 - a-coil
 - air conditioners
 - volt/ohmmeter
 - micron gauge
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- Math:
 - Number sense
 - Working with formulas
 - Applying geometric methods to design problems
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 4

Curriculum: HVAC II

Curricular Unit: Preventative Maintenance

Instructional Unit: H. Perform preventive maintenance on residential/light commercial cooling/heating systems

Standard Alignments (Section 2)

GLE/CLE: N/A

Knowledge: (CA) 3 (MA) 1

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N.Q.1

NETS: 4a

Performance: 1.10, 2.5, 3.5

Unit (Section 3)

Learning Targets:

- **Perform preventive maintenance on air-conditioning systems**
- **Perform preventive maintenance on heating systems**
- Perform preventive maintenance on heat pumps

Instructional Strategies:

- Content is introduced with a teacher-guided lecture-discussion – Classroom discussions: Participate effectively in a range of collaborative discussions
- Students will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative assessment ONLY: Routine maintenance is assessed within multiple other units. Students are required to perform routine maintenance checks and fill out district/teacher created service tickets

Sample Assessment Questions:

- The individual heater wire size is dependent on which of the following: voltage, **current**, kW, or horsepower?

Instructional Resources/Tools:

- Textbook and Workbook: *“Heating and Cooling Essentials”* by Killinger, Goodheart-Wilcox, Co, Inc. © 1999
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear

- Shop equipment/tools, such as:
 - gauge manifold
 - vacuum pump
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- ELA:
 - Technical reading
 - Writing
 - Discussion
- Math: Number sense

Depth of Knowledge (Section 5)

DOK: 2

Curriculum: HVAC I & II

Curricular Unit: Sheet Metal Fabrication and Design

Instructional Unit: I.

- Design an air-distribution system
- Fabricate, insulate, and install air distribution systems
- Size and assemble vents

Standard Alignments (Section 2)

GLE/CLE: N/A Knowledge: (CA) 3,4 (MA) 5 CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; N-Q.3; A-CED.4; G-MG.3 NETS: 4c Performance: 1.5, 1.10, 4.7

Unit (Section 3)

Learning Targets:

- Design an air-distribution system
- **Fabricate, insulate, and install air distribution systems**
- Size and assemble vents

Instructional Strategies:

- Content is demonstrated by the teacher
- Students will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative/summative assessments using a teacher created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks:
 - Students will:
 - practice sheet metal layout from the 40 most frequently used fittings: They will layout and fabricate five designs (4-formative, 1-summative) per packet
 - design, fabricate, and install house ductwork for the Building Trades House

Sample Assessment Questions:

- Project: Layout and fabricate a radius elbow

Instructional Resources/Tools:

- Textbook and Workbook: “*Refrigeration & Air Conditioning Technology*” by Whitman and Johnson, Delmar Cengage Learning © 2009
- Textbook: *Today’s 40 Most Frequently Used Fittings* by Budzik
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools, such as sheet metal hand tools

Cross Curricular Connections:

- Math:
 - Number sense
 - Geometric design
 - Working with formulas
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 4

Curriculum: HVAC II

Curricular Unit: Troubleshooting HVAC systems

Instructional Unit: J. Troubleshoot residential/light commercial cooling/heating systems

Standard Alignments (Section 2)

SCCLE: SC2.2.C (Physics I)

HECLE: HME.4.A

Knowledge: (CA) 3 (H/PE) 7 (MA) 1 (SC) 2

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N.Q.1; S.ID.9

NETS: 4c

Performance: 3.1, 3.5, 1.10

Unit (Section 3)

Learning Targets:

- **Troubleshoot control devices (e.g., mechanical, electromechanical, and electronic)**
- Analyze compressor operation (e.g., electrical and mechanical)
- Analyze and replace a four-way reversing valve
- Troubleshoot electric motors
- **Troubleshoot LP and natural gas fired heating systems**
- **Troubleshoot electric heating systems**
- Troubleshoot heat pumps
- **Troubleshoot air conditioning systems**

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student activity (Textbook Chapters 30, 31, 43):
 - Read Chapters 30, 31, 43: Determine the central idea of a text
 - Demonstrate and explain all unit procedures
- Students will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative – Chapters 30, 31, 43:
 - Written assignment – review questions
 - Workbook activities
- Formative/summative assessments using a teacher created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks:
 - Troubleshooting and repairing a(n):
 - gas furnace
 - electric furnace
 - air-source heat pumps
 - air-conditioners

Sample Assessment Questions:

- The specific gravity of natural gas is:
 - A. 0.08
 - B. 1.00
 - C. 0.42**
 - D. 0.60

Instructional Resources/Tools:

- Textbook and Workbook: “*Refrigeration & Air Conditioning Technology*” by Whitman and Johnson, Delmar Cengage Learning © 2009
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools, such as a:
 - gauge manifold
 - vacuum pump
 - volt/ohmmeter
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- Math:
 - Number sense
 - Causation
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 4

Curriculum: HVAC I and II

Curricular Unit: Demonstrate Professional Customer Relation skills

Instructional Unit: K. Installation of system thermostat and explain system operation to customer

Standard Alignments (Section 2)

GLE/CLE: N/A

Knowledge: (CA) 1 (MA) 1

CCSS: 11-12.SL.1; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N.Q.1

NETS: 4c

Performance: 1.4, 1.8, 2.1

Unit (Section 3)

Learning Targets:

- **Explain operation of the system's thermostat**
- Communicate system operation in lay terms

Instructional Strategies:

- Content is introduced with a teacher-guided lecture/discussion:
 - Classroom discussions: Participate effectively in a range of collaborative discussions
 - Student note taking: Students will summarize and organize information in a note-taking activity
- Student's activity (Textbook Chapters 7: IML Basic Electricity)
 - Read Chapter 7: Determine the central idea of the text
 - Demonstrate and explain all unit procedures
- Students will model/demonstrate all proper safety procedures

Assessments/Evaluations:

- Formative/summative assessment using a teacher created scoring guide. Students will have multiple formative projects preparing them for the summative on each of the following tasks:
 - Correctly wiring a thermostat (digital/snap action) and making sure it works
 - Troubleshooting the thermostat
- Summative: Test assessed using a teacher-created scoring guide

Sample Assessment Questions:

- What are the two colored wires you test for a heat signal? (**white, common**)

Instructional Resources/Tools:

- Textbook/workbook Chapter 7: IML Basic Electricity
- Whiteboard: Used as a:
 - projector board for splashboard and air-server
 - drawing board
- Safety equipment, such as:
 - safety glasses
 - shop wear
- Shop equipment/tools, such as:
 - hand tools such as screwdriver
 - wire strippers
- Teacher-created diagrams
- Media equipment:
 - Newspaper/HVAC magazines
 - iPad

Cross Curricular Connections:

- Math: Number sense
- ELA:
 - Technical reading
 - Writing
 - Discussion

Depth of Knowledge (Section 5)

DOK: 3