

**Technical and Professional
Education**

**Curriculum Content Frameworks for
Electronics**

**Curriculum Content Frameworks for
Electronics
Developed by the
University of Arkansas at Little Rock**

**State of Arkansas
Department of Workforce Education**

NOTICE TO THE READER

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Preface

The Technical & Professional Education program continues to prepare students for employment and continuing education. To accomplish this preparation, teachers and employers have collaborated to modify individual programs to ensure that instruction is current and comprehensive. This document reflects essential competencies for program completers as well as all aspects of the Electronics Industry as required by the Carl D. Perkins Act. The Curriculum Content Frameworks for all Technical & Professional Education programs can be accessed through the Department of Workforce Education Web site.

Forward

The curriculum content framework Electronics supports the course that prepares students for the following career roles, which in turn correspond to the CIP (Classification of Instructional Programs) codes listed below. The courses may be sequenced with a variety of career and technical courses to form a specialization to prepare students for careers and support additional education and training in the protective services industry.

- Career Family: Architecture and Construction
- Career Area: Residential and Commercial Installation and Services
- Career Role CIP Code
- Electrical/Electronics Equipment Installation and Repair 47.0101
- Appliance Installation and Repair Technology/Technician 47.0106
- O-NET – 49-2094.XX

Acknowledgments

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Table of Contents

Introduction 8

Master Duty/Task List

Master Duty/Task List for Electronics I & II.....9 thru 13

Duty/Task Definitions For Electronics I & II

Applying Job and Safety Fundamentals.....14

Orienting Students in Electronics Technology..... 15

Applying Electronics Fundamentals..... 16

Working with DC Circuits 19

Working with AC Circuits 21

Working with Analog Circuits 24

Understanding Digital Logic Systems..... 28

Identifying Computer Elements33

SkillsUSA Task Definitions.....36 thru 40

Related Arkansas Standards of Learning

Introduction.....	41 thru 45
Reading and Writing.....	46 thru 54
Mathematics.....	55 thru 65
Science.....	66 thru 81
SkillsUSA Electronics	82 thru 86
All Aspects of Industry	87 thru 90
Frameworks Cross Reference	91

Introduction

About the Program

Electronics I & II prepares students for careers in the Electronics industry. The course sequence focuses on duties and tasks performed by professionals in Electronics installation and repair occupations, as well as pre-employment and employment skills.

About the Document

- Section 1 contains a master duty/task list for the Electronics program.
- Section 2 contains an analysis of each task, consisting of the task, task definition, and process/skill questions to evaluate acceptable performance. All tasks have been designated essential. Essential tasks are those that must be achieved by every student pursuing the completion of the Aviation Technology program.
- Section 3 lists the Arkansas Standards of Learning for language arts, mathematics, and science that are reinforced by instruction in the Aviation Technology program. Academic skills in these areas are necessary for the mastery of a number of tasks performed by Aviation technicians on the job.

Course Descriptions

494800 – Electronics I

494820 - Electronics II

494810 – Electronics Lab

Students learn to assemble, install, operate, maintain, repair, and troubleshoot electrical/electronic equipment used in industry and manufacturing. Digital and computer circuitry, synchro- and servo-mechanisms, mechanical power transfer systems, three-phase alternate current and electronic wave shaping are included in this program. Completion of this sequence may prepare students for the following certification exams: A+, Certified Computer Service Technician, Certified Electronics Technician, Certified Satellite Dish Installer, Consumer Electronics Certification, Fiber Optics Installer Certification.

Master Duty/Tasks Listing

Electronics I & II

National and state experts in the occupational field of Electronics have validated the duties and tasks in this section. Each is analyzed by identifying the following:

- a *duty/task statement*, which describes what the student is to do

DUTY A: Applying Job and Safety Fundamentals
Task:
A001: Applying Job and Safety Fundamentals
A002: Follow general safety procedures.
A003: Identify first aid procedures for electric shock and other common injuries.
A004: Identify, use, and care for hand and power tools.
A005: Apply soldering and desoldering techniques.
DUTY B: Orienting Students in Electronics Technology
Task:
B001: Identify course expectations.
B002: Describe skills and characteristics of a good electronics technician.
B003: Identify job opportunities available in the field of electronics.
B004: Prepare a portfolio.
B005: Participate in the co-curricular student organization activities.

DUTY C: Applying Electronics Fundamentals
Task:
C001: Explain the nature of electricity.
C002: List ways to produce electrical energy.
C003: Identify electric/electronic components and symbols.
C004: Identify properties of conductors and insulators.
C005: Determine the properties of resistance.
C006: Explore the theory of electromotive force (voltage).
C007: Outline the path of electron flow.
C008: Determine the properties of power.
C009: Explain the construction and operation of circuit protective devices.
C010: Describe types of circuit control devices.
DUTY D: Working with DC Circuits
Task:
D001: Analyze series circuit characteristics.
D002: Analyze parallel circuit characteristics.
D003: Analyze series-parallel circuit characteristics.
D004: Evaluate the difference in voltage between loaded and unloaded voltage divider circuits.

D005: Determine magnetic properties of a circuit or component.
D006: Examine meter movement, using analog and digital multimeters.
DUTY E: Working with AC Circuits
Task:
E001: Identify, use, and care for oscilloscope.
E002: Describe alternating voltage and current.
E003: Determine characteristics of inductance.
E004: Calculate inductive reactance.
E005: Determine characteristics of capacitance.
E006: Demonstrate capacitive reactance.
E007: Explain transformer operations.
E008: Explain the operation of RL and RC networks.
E009: Determine current, voltage, and impedance in an RLC circuit.
E010: Determine resonant frequencies in RLC circuits.
DUTY F: Working with Analog Circuits
Task:
E001: Work with solid-state devices.

E002: Analyze power supplies.
E003: Analyze amplifier circuits.
E004: Analyze oscillator circuits.
E005: Identify amplitude modulation.
E006: Identify frequency modulation.
E007: Define heterodyning.
DUTY G: Understanding Digital Logic Systems
Task:
G001: Identify digital circuitry and signals.
G002: Analyze integrated circuits.
G003: Convert numbers to digital numbering systems.
G004: Identify logic symbols and Boolean expressions.
G005: Construct logic circuit truth tables.
G006: Construct a logic probe or logic pulser.
G007: Troubleshoot a simple logic circuit.
G008: Construct encoder and decoder circuits.
G009: Describe sequential logic circuits.
G010: Construct transistor pulse circuits, counter, and register circuits.

G011: Work with trigger device circuits.
G012: Determine types of arithmetic circuits.
G013: Explain digital memory circuits.
G014: Troubleshoot combinational and sequential logic circuits.
G015: Troubleshoot digital-to-analog and analog-to-digital converters.
DUTY H: Identifying Computer Elements
Task:
H001: Identify micro technology applications.
H002: Explain the basic functions of a computer.
H003: Locate major operational areas.
H004: Connect peripheral equipment.
H005: Identify characteristics of various information storage systems.
H006: Explain microprocessor structure and architecture.

Task Definitions

National and state experts in the occupational field of Electronics have validated tasks in this section. Each task is analyzed by identifying the following:

- a *task definition* (criteria for acceptable performance), which explains what the student has to do to perform the task at the expected level of mastery
- *process/skill questions*, which assess student knowledge and performance.

Tasks are arranged by instructional duty area only. The placement of tasks into specific courses and the sequencing of tasks for instruction are local decisions based on student needs, employer demand, and school schedules.

DUTY A:

Applying Job and Safety Fundamentals

Task:

A001: Follow general safety procedures

Definition: Process should include the following:

- explain use of safety apparel (e.g., eye protection, apron)
- follow safety procedures for working with high energy
- observe safety with hand and power tools
- recognize chemical hazards in the laboratory (MSDS)
- identify types of fires and methods of extinguishing them.

Process/Skill Questions

A002: Identify first aid procedures for electric shock and other common injuries

Definition: Process should include the following:

- describe symptoms of electrical shock
- list guidelines for rescuer safety techniques
- identify methods for treatment of victim
- outline procedures for obtaining medical assistance
- describe correct use of first aid kit and eyewash station
- describe first aid for simulated common injuries such as cuts and burns.

Process/Skill Questions

A003: Identify, use, and care for hand and power tools.

Definition: Process should include the following:

- list common hand tools and power tools such as electric drill, drill press, pliers, soldering aids, and hemostats must be identified by name, function, and procedures for care and storage.

Process/Skill Questions

A004: Apply soldering and desoldering techniques

Definition: Process should include the following:

- state primary reasons why soldering is performed in the electronics industry
- identify soldering tools and materials
- identify methods of soldering/desoldering
- distinguish between good and bad soldering connections
- demonstrate proper soldering/desoldering techniques for various types of connections
- prepare printed circuit board with soldered components.

Process/Skill Questions

**DUTY B:
Orienting Students in Electronics Technology**

Task:

B001: Identify course expectations.

Definition: Process should include the following:

- meet academic prerequisites for the class (reading, writing, math skills)
- review rules and regulations of class and laboratory
- list responsibilities of student and teacher
- discuss class management system.

Process/Skill Questions

B002: Describe skills and characteristics of a good electronics technician.

Definition: Process should include the following:

- possess skills and characteristics to include mathematics background, physical skills/abilities, other educational requirements, expectations of the workplace (e.g., clean criminal record, hours, work habits), and postsecondary education.

Process/Skill Questions

B003: Identify job opportunities available in the field of electronics

Definition: Process should include the following:

- list opportunities in a variety of fields identified from instructor-provided resources, including newspapers, trade journals, and other printed sources; software; online sources; employment commission and other agencies.

Process/Skill Questions

B004: Prepare a portfolio.

Definition: Process should include the following:

- list contents of the portfolio and summarizing the student's experience in introduction
- include resume, letters of recommendation, college or employment application in career development package
- demonstrate student's skills using work samples
- describe a research topic in electronics field
- document student's practical or work experience

Process/Skill Questions

B005: Participate in the co-curricular student organization activities.

Definition: Process should include the following:

- identify advantages and responsibilities of SkillsUSA–VICA membership
- identify competitive events and opportunities
- explain structure and organization of SkillsUSA–VICA.

Process/Skill Questions

**DUTY C:
Applying Electronics Fundamentals**

Task:

C001: Explain the nature of electricity.

Definition: Process should include the following:

- define electronics and electricity
- define matter and list its forms
- identify relationships among matter, elements, compounds, molecules, mixtures, nuclei, atoms, electrons, protons, neutrons, energy, valence, valence shells, and ions

Process/Skill Questions

C002: List ways to produce electrical energy.

Definition: Process should include the following:

- define matter and list its forms
- identify relationships among matter, elements, compounds, molecules, mixtures, nuclei, atoms, electrons, protons, neutrons, energy, valence, valence shells, and ions.
- explain how electricity is produced using friction, heat, light, pressure, chemical action, and magnetism

Process/Skill Questions

C003: Identify electric/electronic components and symbols.

Definition: Process should include the following:

- identify components and their graphic symbols correctly by name
- identify components including resistors, capacitors, switches, circuit breakers, and others selected by the instructor

Process/Skill Questions

C004: Identify properties of conductors and insulators.

Definition: Process should include the following:

- state from a cross-sectional area the length and material for conductors and type of material for insulators

Process/Skill Questions

C005: Determine the properties of resistance.

Definition: Process should include the following:

- identify ohmic value, using an ohmmeter or reading the color code
- identify power rating, considering physical size, markings, and manufacturer's considerations
- identify tolerance range (percentage), using color code

Process/Skill Questions

C006: Explore the theory of electromotive force (voltage).

Definition: Process should include the following:

- define and measure voltage, using a voltmeter
- measure potential difference (measures electromotive force), using voltmeter for various DC power sources
- calculate voltage, using Ohm's Law

Process/Skill Questions

C007: Outline the path of electron flow.

Definition: Process should include the following:

- define the term current
- measure current using an ammeter
- calculate current using Ohm's Law

Process/Skill Questions

C008: Determine the properties of power.

Definition: Process should include the following:

- define power and work
- calculate power using Watt's Law
- describe the principles of maximum power transfer theorem.

Process/Skill Questions

C009: Explain the construction and operation of circuit protective devices.

Definition: Process should include the following:

- define shorted circuit, open circuit, ICP (integrated circuit protection), circuit breaker, fuse, fusible resistor, and thermistor
- demonstrate use of a testing device to determine condition of a circuit protection device

Process/Skill Questions

C010: Describe types of circuit control devices.

Definition: Process should include the following:

- describe construction, number, and location of terminal connections on various types of switches and relays
- describe operation of various switches and relays
- describe significance of voltage and current ratings
- explain abbreviations SPST, SPDT, DPST, DPDT, N.O., and N.C.
- illustrate how to hook up three-way switches for two points of control

Process/Skill Questions

**DUTY D:
Working with DC Circuits**

Task:

D001: Analyze series circuit characteristics.

Definition: Process should include the following:

- define characteristics of a series circuit
- calculate current, voltage, resistance, and power in a series circuit, using Ohm's Law, Watt's Law, and Kirchoff's Law
- measure resistance, voltage, and current in a series circuit
- identify series circuits at home and in industry
- troubleshoot series circuits
-

Process/Skill Questions

D002: Analyze parallel circuit characteristics.

Definition: Process should include the following:

- define characteristics of a parallel circuit
- calculate current, voltage, resistance, and power in a parallel circuit, using Ohm's Law, Watt's Law, and Kirchoff's Law
- measure resistance, voltage, and current in a parallel circuit
- identify parallel circuits at home and in industry
- troubleshoot parallel circuits

Process/Skill Questions

D003: Analyze series-parallel circuit characteristics.

Definition: Process should include the following:

- define characteristics of a series-parallel circuit
- calculate current, voltage, resistance, and power in a series-parallel circuit, using Ohm's Law, Watt's Law, and Kirchoff's Law
- measure resistance, voltage, and current in a series-parallel circuit
- identify series-parallel circuits at home and in industry
- troubleshoot series-parallel circuits

Process/Skill Questions

D004: Evaluate the difference in voltage between loaded and unloaded voltage divider circuits.

Definition: Process should include the following:

- define unloaded voltage divider, loaded voltage divider, loads, and reference points
- explain purposes of a voltage divider
- list examples of uses of a voltage divider
- calculate various voltages, resistances, currents, and power in a voltage divider network

Process/Skill Questions

D005: Determine magnetic properties of a circuit or component.

Definition: Process should include the following:

- define magnetic field, induced current polarity, lines of flux, left-hand rule, and Oersted, Gilbert, Lenz, Maxwell and Gauss units of magnetism
- use left-hand rule to determine direction of induced current for generators
- explain principles of electromagnetism
- explain principles and operation of D'Arsonval meter movement
- use right-hand rule to determine direction of induced current for motors
- explain magnetic operation of relay.

Process/Skill Questions

D006: Examine meter movement, using analog and digital multimeters.

Definition: Process should include the following:

- define meter sensitivity, shunts, multipliers, internal resistance, loading, and Wheatstone bridge
- explain operation of a Wheatstone bridge
- explain internal resistance and loading effect

Process/Skill Questions

DUTY E:
Working with AC Circuits

Task:

E001: Identify, use, and care for oscilloscope.

Definition: Process should include the following:

- recognize and understand parts and functions of an oscilloscope
- manipulate front-panel controls to adjust circuits for proper operation
 - measure AC and DC voltages
 - gain information about the shape, time period, and frequency of voltage waveforms
 - maintain oscilloscope according to manufacturer's specifications

Process/Skill Questions

E002: Describe alternating voltage and current.

Definition: Process should include the following:

- define alternating current, cycle, alternation degrees, frequency, sine, cosine, tangent, Hertz, peak, sine curve, and amplitude
- measure AC voltage, using meter and oscilloscope
- measure frequency and amplitude of an AC signal, using an oscilloscope and signal generator
- calculate instantaneous and average values and effective (RMS) voltage or current
- convert RMS to peak, peak to peak, frequency to time, and time to frequency
- measure current and voltage in an AC resistive circuit

Process/Skill Questions

E003: Determine characteristics of inductance.

Definition: Process should include the following:

defining Henry, inductor, inductance, Lenz's Law and phase relationships

- explain physical properties of an inductor
- explain electrical characteristics of an inductor
- construct a simple inductive circuit, and observing results of changing frequency or inductance
- demonstrate use of a voltmeter, oscilloscope, and signal generator
- draw schematic symbol for an inductor

Process/Skill Questions

E004: Calculate inductive reactance.

Process should include the following:

- explain inductive reactance and phase relationships
- describe relationship between inductive reactance and frequency
- interpret formula $X_L = 2\pi fL$
- draw waveform of a purely inductive circuit showing phase relationship of voltage and current
- show phase relationship of voltage and current

Process/Skill Questions

E005: Determine characteristics of capacitance.

Definition: Process should include the following:

- define capacitor, dielectric, dielectric constant, microfarad, nanofarad, picofarad, and working voltage
- describe construction of various types of capacitors
- draw schematic symbols for fixed capacitors, variable capacitors, and polarized electrolytic capacitors
- explain significance of voltage rating and capacitance rating of capacitors
- calculate parallel capacitance, use the formula $C_T = C_1 + C_2 + C_3 \dots C_N$
- calculate series capacitance, use the formula $C_T = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_n}}$
- list and explain safety factors involved in handling all types of capacitors

Process/Skill Questions

E006: Demonstrate capacitive reactance.

Definition: Process should include the following:

- explain capacitive reactance
- state Ohm's Law and explaining its application to capacitive reactance
- list reactance factors
- interpret formula $X_C = \frac{1}{2\pi fc}$
- draw the waveform of a purely capacitive circuit showing the phase relationship of voltage and current

Process/Skill Questions

E007: Explain transformer operations.

Definition: Process should include the following:

- describe different types of transformer construction
- sketch schematic diagrams of different types of transformers
- state methods of identifying primary and secondary leads
- list all safety procedures to observe when connecting equipment to power lines
- measure primary and secondary voltage
- calculate turns ratio, voltage ratio, primary and secondary currents, and efficiency of a transformer

Process/Skill Questions

E008: Explain the operation of RL and RC networks.

Definition: Process should include the following:

describe Pythagorean theorem and demonstrating how to apply it

- identify and describe properties of RL and RC circuits
- explain impedance and phase angle
- convert circuit diagrams into phase diagrams
- sketch diagrams of RL and RC series and parallel circuits and assigning values for resistance, capacitance, inductance, frequency, and applied voltage
- calculate inductive reactance (X_L), capacitive reactance (X_C), impedance (Z), voltage across resistor (E_R), voltage across inductor (E_L), and voltage across capacitor (E_C)
- draw a phasor diagram for RL and RC circuits and calculate time constant for both
- explain power factor correction

Process/Skill Questions

E009: Determine current, voltage, and impedance in an RLC circuit.

Definition: Process should include the following:

- identify components of RC and RL circuits
- explain how to derive the formula $Z = \sqrt{R^2 + (X_L - X_C)^2}$
- state effect of frequency changes on current, voltage, and impedance
- describe why total impedance is capacitive or reactive
- identify uses of RLC circuits

Process/Skill Questions

E010: Determine resonant frequencies in RLC circuits.

Definition: Process should include the following:

- define RLC circuit and high-Q parallel circuit
- explain various ways resonance is defined
- apply reactance formulas
- interpret $F_r = \frac{1}{2\pi\sqrt{LC}}$
- demonstrate how to use the formula to find resonant frequency
- state reasons why X_L must equal X_C
- explain function of low-pass, high-pass, and band-stop filter circuits
- troubleshoot filter circuits

Process/Skill Questions

**DUTY F:
Working with Analog Circuits****Task:****F001: Work with solid-state devices.**

Definition: Process should include the following:

- describe diode construction
 - identify characteristics associated with each type of material used in construction of diodes
 - describe process of doping
 - define *holes, acceptor dopant, donor dopant, barrier region, intrinsic, avalanche, and transit time*
 - identify minority and majority current carriers
 - draw a block diagram of a PN junction and indicate barrier region
- determine diode parameters
 - explain effect of heat on minority carriers as it relates to leakage current
 - describe forward and reverse bias of a PN junction
 - explain and draw characteristic curve of a diode
 - draw schematic symbol of a diode and use a multimeter to identify anode and cathode
 - explain reverse breakdown of a diode (PIV/PRV)
 - identify substitutes in a reference manual and state diode numbers, types, and PIV
 - using a multimeter to test a diode
- demonstrate uses of diodes
 - explain operation of zener diodes
 - explain operation of a clipper and clamper circuit
 - state practical applications of diodes
 - construct a circuit that results in agreement in instructor's waveforms and output voltage measurements

- describe transistor construction
 - identify types of materials used in transistor construction
 - draw block diagrams illustrating types of junctions made with N and P materials
 - explain term *bipolar*
 - name elements of a transistor
 - describe process of doping transistor elements
- determine transistor parameters
 - explain biasing required by a transistor to operate
 - explain relationship of I_E and I_B and I_C
 - describe voltage potential required by the emitter-base junction
 - state meaning of alpha (α), beta (β), h_{fe} , V_C , V_E , V_B , V_{CD} , and transit time
 - identify transistors by case and numbers
 - identify leads of various transistors based on case design
 - explain DC parameters of transistors
- demonstrate uses of transistors
 - describe basic circuit configurations of a transistor amplifier
 - explain advantages and disadvantages of the CE, CC, and CB circuits
 - construct a circuit to demonstrate the use of a transistor as a switch and explain its operation
 - state practical applications of transistors
- analyze the uses of special solid state devices
 - describe the function of an FET, UJT, MOSFET, and PUT
 - explain the uses of an LED, DIAC, TRIAC, SCR, and LASCR
 - describe the function of a silicon unilateral switch (SUS), silicon bilateral switch (SBS), photodiode, and phototransistor
 - state effects of electrostatic discharge
- troubleshoot transistor circuits according to a prescribed troubleshooting procedure
 - construct a single-stage transistor circuit
 - calculate the currents and voltages of a transistor circuit
 - analyze circuit problems using voltage and resistance checks
 - demonstrate the use of a ohmmeter (VOM/DMM) to check both diodes and transistors
 - demonstrate the use of a diode and transistor checker

Process/Skill Questions

F002: Analyze power supplies.

Definition: Process should include the following:

- describe power supply circuit requirements
 - draw a block diagram of a power supply with filter
 - define *ripple*, *filter*, *regulation*, and *rectify*
 - list requirements to consider when designing a power supply
 - explain why AC voltage is converted to DC voltage for use in electronic devices
- determine rectifier configurations
 - construct a half-wave rectifier circuit
 - construct a full-wave rectifier circuit

- construct a full-wave bridge rectifier circuit
- explain operation of a half-wave and full-wave voltage doubler circuit
- state all safety precautions to be observed while working with various circuits
- explain switch-mode and scan power supplies.
- determine filter qualities
 - explain by waveform analysis the action of a capacitor as a filter in a rectifier circuit
 - describe operation of a choke input and capacitor input filter circuit
 - construct a rectifier circuit with a PI filter or RC filter
 - use an oscilloscope to measure the DC output voltage and ripple voltage of the constructed power supply
 - explain formula $\% = \frac{V_{fl} - V_{nl}}{V_{fl}} \times 100$
 - calculate and measure ripple and regulation percentages in agreement with instructor's data sheet.
- troubleshoot a power supply according to a prescribed troubleshooting procedure
 - construct a power supply
 - perform an operational check of the power supply
 - formulate a data sheet based on results of the operational test
 - perform troubleshooting procedures to component level
 - identify replacement parts

Process/Skill Questions

F003: Analyze amplifier circuits.

Definition: Process should include the following:

- identify types and applications of amplifiers
 - define *linear, cutoff, operating points, distortion, load lines, and decibel gains*
 - draw and explain operation of a common emitter (CE) amplifier
 - draw and explain operation of a common base (CB) amplifier
 - draw and explain operation of a common collector (CC) amplifier
 - state uses of various types of amplifiers
 - list four classes of amplifiers and stating the amount of input wave each controls.
- identify methods of biasing and coupling
 - draw a schematic diagram of a direct-coupled amplifier circuit
 - explain operation of a transformer-coupled amplifier and describe biasing arrangements
 - label resistance-capacitance-coupled amplifier circuits on a drawing of a two-stage amplifier
 - list advantages and disadvantages of direct-coupled, transformer-coupled, and resistance-capacitance coupled amplifier circuits.
- determine amplifier circuit construction
 - define *positive feedback, negative feedback, current feedback, voltage feedback, distortion, crossover, clipping, and harmonics*
 - identify coupling type
 - describe types of feedback and listing the advantages of each

- describe high and low frequency cutoff points
- explain types of distortion and listing a disadvantage of each.
- troubleshoot an amplifier
 - construct a two-stage RC-coupled amplifier
 - perform hypothetical calculations
 - perform an operational check
 - verify circuit operation by instructor
 - identify and replacing faulty component
 - perform operational check
 - verify amplifier operation by instructor

Process/Skill Questions

F004: Analyze oscillator circuits.

Definition: Process should include the following:

- - define *relaxation oscillator, blocking oscillator, ticker coil, VFO, BFO, ECO, TPTG oscillator, crystal, and phase-lock loop*
 - compare schematics of various oscillators by identifying component placement and other distinguishing characteristics
 - trace on a schematic the feedback path circuit of an oscillator circuit
 - draw a schematics of an RC feedback oscillator circuit
- - define *tank circuit, oscillation, feedback, multivibrator, and phase shift*
 - identify uses of oscillator circuits
 - name four types of oscillator circuits
 - state conditions that must be satisfied for oscillations to occur
 - identify oscillator type in three different oscillator circuits
- - construct a collector-coupled multivibrator circuit
 - perform an operational test of the multivibrator
 - formulate a data sheet based on the results of the operational test
 - identify procedures to follow to locate faulty components.
 - verify oscillator circuit operation according to prescribed troubleshooting procedure

Process/Skill Questions

F005: Identify amplitude modulation.

Definition: Process should include the following:

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Process/Skill Questions

F006: Identify frequency modulation.

Definition: Process should include the following:

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-

Process/Skill Questions

F007: Define heterodyning.

Definition: Process should include the following:

- - super heterodyne circuit
 - local oscillator
 - mixer stage
 - intermediate frequency

Process/Skill Questions

**DUTY G:
Understanding Digital Logic Systems**

Task:

G001: Identify digital circuitry and signals.

Definition: Process should include the following:

- define *integrated circuit (IC), dual in-line package (DIP), flat pack, digital, and linear IC*
- draw block diagram of a 14-pin DIP integrated circuit and label pin numbers in order
- explain difference between a digital and an analog signal
- list five devices that use digital circuits
- draw a digital signal that is 3 volts in amplitude and label it as binary 0 and 1
- construct a free-running clock circuit and measure its frequency

Process/Skill Questions

G002: Analyze integrated circuits.

Definition: Process should include the following:

- note on a data sheet the following specifications for 8 of 10 circuits within 40 minutes
 - supply voltage
 - operating temperature range
 - grounds
 - power dissipation
 - linear or nonlinear classification
- determine operational amplifier (op amp) characteristics based on constructing an op amp circuit, verifying operation, and calculating voltage gain
- ensure circuit is operational and constructed in accordance with schematic specifications; calculations must be within 5% of ideal value

Process/Skill Questions

G003: Convert numbers to digital numbering systems.

Definition: Process should include the following:

- define *binary, octal, hexadecimal, base numbers, encoder, decoder, bit, and byte*
- convert decimal number to binary numbers
- convert decimal numbers to hexadecimal to decimal
- convert binary numbers to hexadecimal to decimal
- explain function of an encoder and decoder
- add, subtract, multiply, and divide binary numbers
- construct an encoder circuit
- construct a decoder circuit

Process/Skill Questions

G004: Identify logic symbols and Boolean expressions.

Definition: Process should include the following:

- draw AND and OR gate symbols and the Boolean expression for each
- draw a inverter symbol and the Boolean expression
- draw NAND and NOR gate symbols and the Boolean expression for each
- draw XOR and XNOR gate symbols and the Boolean expression for each
- construct specified logic circuits
- explain how a NAND gate can be used to construct other gates
- explain how a truth table is constructed
- differentiate between positive and negative logic
- explain differences between transistor-transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) circuits
- list IC handling and soldering safety procedures

Process/Skill Questions

G005: Construct logic circuit truth tables.

Definition: Process should include the following:

- draw a circuit diagram from a Boolean expression
- drawing a circuit diagram from a truth table
- construct a truth table from a Boolean expression
- form a maxterm Boolean expression from a truth table
- simplify a Boolean expression
- design a Karnaugh map from a truth table
- draw a NAND logic diagram from a four-variable truth table

Process/Skill Questions

G006: Construct a logic probe or logic pulser.

Definition: Process should include the following:

- construct a logic probe on a breadboard and perform operational test
- construct a logic pulser on a breadboard and perform operational test
- explain use of logic probes and pulsers in troubleshooting digital circuits

Process/Skill Questions

G007: Troubleshoot a simple logic circuit.

Definition: Process should include the following:

- perform a functional check of the circuit
- formulate a truth table based on the results of the functional test
- perform troubleshooting procedures to locate the faulty IC and the faulty gate circuit within that IC
- remove and replace the faulty component and repeat functional check.
- verify circuit operation according to prescribed troubleshooting procedures

Process/Skill Questions

G008: Construct encoder and decoder circuits.

Definition: Process should include the following:

- convert decimal numbers to Binary Coded Decimal (BCD)
- wire a seven-segment LED to display all segments
- explain function of decoder/driver and draw a pinout diagram
- troubleshoot an encoder and a decoder circuit drawing
- explain function of a multiplexer and a demultiplexer and draw a pinout diagram for each
- troubleshoot a multiplexer and demultiplexer circuit drawing

Process/Skill Questions

G009: Describe sequential logic circuits.

Definition: Process should include the following:

- define *sequential, latch, transistor pulse, synchronous, asynchronous, positive edge triggering, disabled, enabled, and toggling*
- explain function of a transistor pulse
- explain how a latch is used to store information
- construct a frequency divider circuit
- solve pulse train problems for an IC counter
- explain differences in a serial load and parallel load shift register

Process/Skill Questions

G010: Construct transistor pulse circuits, counter, and register circuits.

Definition: Process should include the following:

- describe operation of a D-type transistor pulse circuit
- construct a debounce switch circuit
- construct a 4-bit shift register
- construct a divide-by-two circuit using transistor pulse circuits
- describe operation of a binary counter
- read a transistor pulse circuit truth table and construct a circuit based on the table
- draw pulse train diagrams of two transistor pulse circuits

Process/Skill Questions

G011: Work with trigger device circuits.

Definition: Process should include the following:

- describe difference between synchronous and asynchronous flip flops
- explain two classifications of synchronous flip flops
- demonstrate positive and negative edge triggered flip flops
- name flip flop that utilizes both the negative and positive edge of the clock pulse
- construct a Schmitt Trigger circuit
- draw schematic symbol for the Schmitt trigger inverter

Process/Skill Questions

G012: Determine types of arithmetic circuits.

Definition: Process should include the following:

- solve binary arithmetic problems
- explain how to make a full-adder, using two half-adders
- identify pinout of a 4-bit full-adder
- solve binary multiplication problems
- explain 2s complement method of converting decimal numbers
- troubleshoot a full-adder circuit drawing
- construct a full-adder circuit

Process/Skill Questions

G013: Explain digital memory circuits.

Definition: Process should include the following:

- define *RAM, ROM, EPROM, PROM, scratch-pad, sequential access, static, volatile, nonvolatile, and ECL*
- describe difference between sequential and random access
- list characteristics of bipolar memory and metal oxide semiconductor (MOS) memory
- list steps in troubleshooting ROMs and RAMs

Process/Skill Questions

G014: Troubleshoot combinational and sequential logic circuits.

Definition: Process should include the following:

- demonstrate use of a logic probe
- demonstrate use of a logic monitor
- draw output waveforms of sequential logic circuits
- explain steps in troubleshooting
- explain use of truth tables in troubleshooting

Process/Skill Questions

G015: Troubleshoot digital-to-analog and analog-to-digital converters.

Definition: Process should include the following:

- explain special interface encoders and decoders used between analog and digital devices
- describe how operational amplifiers are used in Digital to Analog (D/A) converters and comparators
- name at least three common Analog to Digital (D/A) converters
- list common specifications used for A/D converted to include such characteristic as type of output resolution, conversion time, accuracy, power supply voltage and input/output voltage levels
- name a digital piece of electronic equipment that contains a A/D converter
- build a circuit using a A/D converter chip such as the ADC0804 IC

Process/Skill Questions

**DUTY H:
Identifying Computer Elements**

Task:

H001: Identify micro technology applications.

Definition: Process should include the following:

- state two main categories of micro technology applications
- explain and give four examples of *dedicated control*
- describe concept of computer-aided instruction (CAI)
- explain how computers can benefit industry and business

Process/Skill Questions

H002: Explain the basic functions of a computer.

Definition: Process should include the following:

- list ways data is processed
- describe how a computer might be used to time or sequence events
- give examples of computers used as industrial control devices
- describe use of the computer as a monitoring device

Process/Skill Questions

H003: Locate major operational areas.

Definition: Process should include the following:

- identify location of the power supply
- explain term *motherboard*
- describe uses and types of input/output devices
- list parts and state functions of the CPU
- list two types of information stored in the memory
- determine available memory of a selected computer

Process/Skill Questions

H004: Connect peripheral equipment.

Definition: Process should include the following:

- match terms related to peripherals with correct definitions
- explain printer interfacing modes
- list differences among dot matrix, ink jet, and laser printers
- explain protocol
- describe how a modem works
- save files from a digital camera
- scan images for print or use in a document
- compare and contrast floppy disk and hard disk drives
- solve a cable configuration problem
- list four classifications of computer monitors
- prepare cables for connection

Process/Skill Questions

H005: Identify characteristics of various information storage systems.

Definition: Process should include the following:

- name two basic types of semiconductor storage elements
- explain operation of static and dynamic memory elements
- identify types and explain operation of read-only memories
- explain memory organization and memory size
- name three current applications of ROMs as mass-storage devices
- explain use of magnetic tape memory
- identify format of a floppy disk

Process/Skill Questions

H006: Explain microprocessor structure and architecture.

Definition: Process should include the following:

- *define register, opcode, address, instruction word, accumulator, execution, LDA, HLT, stack, pointer, and subroutine*
- name major registers of a microprocessor
- explain how a CPU executes a program
- describe microprocessor construction
- describe microprocessor architecture

Process/Skill Questions

SkillsUSA

Task Definitions

DUTY A: Self - Improvement
Task:
<p>A001: Complete a self-assessment and identify individual learning styles</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify and list individual strengths. • Identify and list areas in need of improvement. <p>Process/Skill Questions</p>
<p>A002: Discover self-motivation techniques and establish short-term goals</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Develop a list of short-term goals. • Discuss ways to change or improve lifestyle appearance and behavior. <p>Process/Skill Questions</p>
<p>A003: Determine individual time-management skills</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Prepare and keep a time journal. • Discuss ways to improve time management skills. <p>Process/Skill Questions</p>
<p>A004: Define future occupations</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Search internet for career opportunities within specified fields of study. • Prepare presentation on a specified career area. <p>Process/Skill Questions</p>
<p>A005: Develop awareness of cultural diversity and equity issues</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Research a tradition modeled by individual's family. • Develop personal philosophy statements regarding gender equity.

Process/Skill Questions

A006: Define the customer

Definition: Process should include the following:

- Differentiate between External and Internal customers
- Discuss factors which contribute to poor customer relationships.

Process/Skill Questions

A007: Recognize benefits of doing a community service project

Definition: Process should include the following:

- Discuss and list ways to become involved in the community
- Develop a community service project.

Process/Skill Questions

A008: Demonstrate effective communication with others

Definition: Process should include the following:

- Identify and list personal barriers to listening.
- Develop personal plan to overcome barriers to listening.

Process/Skill Questions

A009: Participate in a shadowing activity

Definition: Process should include the following:

- Summarize experience of job shadowing activity.

Process/Skill Questions

A010: Identify the components of an employment portfolio

Definition: Process should include the following:

- Identify parts of a portfolio
- Design a personal employment portfolio

Process/Skill Questions

A011: List proficiency in program competencies

Definition: Process should include the following:

- Complete an interpersonal competency assessment.

Process/Skill Questions

<p>DUTY B: Civic, Social and Business Awareness</p>
<p>Task:</p>
<p>B001: Measure/modify short-term goals</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss steps to pursue short-term goal(s) <p>Process/Skill Questions</p>
<p>B002: Identify stress sources</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • List personal sources of stress. • Discuss techniques to cope with individual sources of stress. <p>Process/Skill Questions</p>
<p>B003: Select characteristics of a positive image</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss actions and traits that lead to a positive image. • Discuss actions and traits that lead to a negative image. <p>Process/Skill Questions</p>
<p>B004: Demonstrate awareness of government, professional organizations and trade unions</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify state governor, legislators, and senators. • Identify professional organizations pertaining to specific career areas. <p>Process/Skill Questions</p>
<p>B005: Apply team skills to a group project</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Form a team to develop a class project. <p>Process/Skill Questions</p>
<p>B006: Observe and critique a meeting</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Attend a formal meeting held within the community • Critique the attended meeting. <p>Process/Skill Questions</p>

B007: Demonstrate business meeting skills

Definition: Process should include the following:

- List and discuss the basic rules to ensure an orderly and business-like meeting
- Role-play appropriate meeting skills

Process/Skill Questions

B008: Demonstrate social etiquette

Definition: Process should include the following:

- Role-play appropriate social behavior
- Differentiate between good and bad manners.

Process/Skill Questions

B009: Complete survey for employment opportunities

Definition: Process should include the following:

- Gather information on a particular employment opportunity of interest.
- Conduct internet search of a specific career area.

Process/Skill Questions

B010: Review a professional journal and develop a 3 to 5 minute presentation

Definition: Process should include the following:

- Develop a presentation on the content, purpose, and distribution of a particular professional journal

Process/Skill Questions

B011: Identify customer expectations

Definition: Process should include the following:

- List and discuss customer expectations.
- Discuss consequences of unmet customer expectations.

Process/Skill Questions

B012: Complete a job application

Definition: Process should include the following:

- Obtain a job application from various businesses in the community
- Conduct a mock job interview.

Process/Skill Questions

B013: Identify a mentor

Definition: Process should include the following:

- Define mentor.
- Discuss ways in which a mentor can help an individual meet career goals.

Process/Skill Questions

B014: Assemble your employment portfolio

Definition: Process should include the following:

- Develop employment portfolio

Process/Skill Questions

B015: Explore supervisory and management roles in an organization

Definition: Process should include the following:

- Examine an organizational chart
- Discuss responsibilities of managers and supervisors

Process/Skill Questions

B016: Recognize safety issues

Definition: Process should include the following:

- Discuss safety issues within a given career area

Process/Skill Questions

B017: Evaluate your proficiency in program competencies

Definition: Process should include the following:

- Define task and competency
- List competencies associated with a specified career area.

Process/Skill Questions

Technical And Professional Curriculum Frameworks

Purpose

This section of the framework contains material to help instructors in technical and professional programs to reinforce basic skills in the areas of Reading and Writing, Math and Science. The technical portion of this guide takes a more direct approach by using specific duty and task listings, but changes in the academic section lead in a more general direction. The reason for this is simple: all good instructors do not teach in the same way. However, all good instructors share the trait of being able to connect their material to everyday life. For example, understanding concepts related to heat, are important for cosmetology students as well as lathe operators in manufacturing plants. However, each program will probably take a different approach in the amount of detail and examples relating to heat concepts. Both groups require basic science knowledge of principles relating to heat, but the application of the principles will be different.

Basic Skills: The Content Areas

Included in this guide are materials to support basic skills in Reading and Writing, Mathematics, and Science. The overall approach taken here is a move toward problem-solving skills. By problem-solving, we mean the ability to take information and use it for a purpose: to take action, make decisions, predict outcomes, suggest improvements. Another term for these thinking skills is a general “literacy.”

Literacy skills have always been in demand in the workplace. A quick review of workplace training programs and other literature regarding adult education demonstrates that the need for a literate workforce is still one of the most pressing problems employers face today. Indeed, many employers (from small- and medium-sized businesses to Fortune 500 companies) have spent hundreds of millions of dollars on in-house basic skills training programs.

What constitutes a literate workforce? There are many definitions for literacy and hundreds of tests that measure it, but when employers are asked what they're looking for in potential new hires, the answers are general: they want individuals who can read and write; show up on time; think and solve problems, and keep their personal lives in order (that is, don't bring a drinking problem into the workplace).

Viewed in this way, the words "literacy" and "literate" are good terms for what educators are trying to instill in their students, the future workforce. The more common definition (being able to read and write) is certainly appropriate but the additional definitions (knowledgeable, educated, well-informed) are also apt. It is this broad term, "literate," that we use to guide instructors on what to cover in the classroom. No matter which vocational-technical area is being focused on, no matter how technical the terminology is, instructors are given the task of helping students take information, break it down into necessary parts, process details, and be able to come away with an understanding of some sort. This is "literacy", and the process is the same for every subject area-- teaching students how to think and solve problems.

Format

Each section includes a two-column table. Skills are listed on the left side; suggestions for implementing these skills into the curriculum are listed on the right side. Each suggestion is written in such a way that it can be tailored to most vocational-technical programs.

Using The Guide

This guide was prepared with four concepts in mind:

- The instructor is *aware of the need* for students to improve their basic skills.
- The instructor is the *best-qualified person* to decide how to include this material in the classroom or lab. The students' abilities and needs should drive the instructor in deciding how to use, expand, or modify these topics.
- The instructor *already has curriculum that works* for his or her students. Therefore, the suggestions for reinforcing basic skills
 - must be easy to implement
 - must stand alone

- do not need to be taught in a particular order
 - must be open-ended enough to be useful for any technical/vocational program.
- ***Time is limited.*** Unless there are quick ways to reinforce basic skills, changes to the curriculum will not be made. Teaching basic skills in the context of technical material will help students make connections that are more memorable, and will require no additional lesson planning. Just as instructors incorporate updates in technical knowledge, they can add basic skills concepts as well. Adding a few concepts at a time will help students perform better in the lab as well as on tests and evaluations.

Methods

The following methods may help instructors decide how to increase basic skill knowledge:

- *Collaborative projects*- how could a joint project between regular education teachers and vocational instructors reinforce concepts for both programs?
- *Outside assignments*- would students benefit from an outside assignment explaining how a basic math (science, reading) concept ties to a process in the lab?
- *Extra credit*- students needing extra credit can research outside topics and turn in a short summary of material
- “*Need-to-know*” *assignments*- Students prepare a bulleted list of the basic concepts in science they need to know in order to correctly perform ____ operation in the lab.
- *Question of the Day*- a few daily math problems for students to answer at the beginning of class allows the instructor to set the tone for the material. It also gives students an immediate goal when they enter the classroom and teaches them to stay on task. Bonus points may be awarded at the end of the week, quarter, semester, etc.
- *Two-minute Oral Presentations*- students who need to practice speaking skills can be asked to give a two-minute oral presentation at the end of class summarizing the main points for the day. Or, a two-minute presentation at the beginning of class can recap the material from a previous class.
- *Connecting with Workers*- students can poll parents, friends, area employers or other persons to find out the top 5 basic science skills needed on the job.

- *Direct Questioning*- include a few basic knowledge questions in a presentation. Award points to groups based on correct answers.

Resources

In creating the Academic Reinforcement material for the technical and professional frameworks, we used a number of source documents and resources.

- The English Language Arts, Science, and Mathematics components of the *Curriculum Improvement Project* by Dr. Willard Daggett were consulted to ensure that the top-ranked skills in those areas would be reflected in the academic support material. The English Language Arts and Science components have many linkages to the material included here. (The higher-level math skills such as trigonometry were not included in this document.)
- Data from work with Arkansas employers- the Workplace Skills Enhancement Program (WSEP) at the University of Arkansas at Little Rock (UALR) has completed many training projects and job profiles for employers in Arkansas. Our constant contact with workers and employers provides a tremendous amount of data that we use in designing customized training programs and in working on projects such as curriculum frameworks. Also, the staff of WSEP has experience teaching in Arkansas public schools, the US military, and the Job Corps.
- Additionally, other groups within UALR (the Labor Education Program, the Institute for Economic Advancement and the College of Business) provide resources regarding health and safety information, labor unions and their role in the workplace, computer and information technology and other training and outreach program data.
- US Department of Labor- the US DOL has many online documents and publications that support workers and issues regarding the workplace. (Work by Philippi and Greenan, 1988 on workplace skills was especially helpful.) Visit the website at www.dol.gov.
- Occupational Safety and Health Administration (OSHA) provides online and other resources for instructors and professionals. For topics relating to safety and health, visit www.osha.gov.

- Multistate Academic and Vocational Curriculum Consortium (MAVCC) is an organization that develops competency-based curriculum. For more on MAVCC see www.mavcc.org.

ACADEMIC STANDARDS FOR READING AND WRITING

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Objective	Classroom Applications to Industry
<p><i>Present,</i> <i>Review and Discuss,</i> Master the list of skills employers want for the workplace regarding reading and writing.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
<p><i>Answer</i> simple comprehension or recall questions from a lecture or from written material.</p>	<p>Provide 2 examples of workplace materials* on students' reading level.</p> <p>With the first, allow students to read information and then answer brief recall questions.</p> <p>With the second example, read aloud the material but do not give a handout. Ask brief recall questions.</p> <p>Compare the differences...how do students retain information better—orally or visually? Discuss learning styles and impact on the job.</p>
<p><i>Follow,</i> Give oral instructions.</p>	<p>Using instructions for a hands-on task, have students give <u>oral</u> instructions to a partner or group. Rate the effectiveness of the speaker.</p>

<i>Follow,</i> Give written instructions.	Using a short list of instructions for a hands-on task, have students give <u>written</u> instructions to a partner or group. Rate the effectiveness of the speaker.
Show the difference between relevant and irrelevant details.	Using a copy of workplace materials*, students underline relevant or important details in red, irrelevant or less important details in blue.
Sort objects based on x number of criteria.	Using workplace materials*, sort a group of objects based on characteristics identified by instructor (e.g., by color, shape, defect, or a combination of these).
<i>Recognize,</i> Identify technical vocabulary.	Using workplace materials*, highlight technical vocabulary terms. Create a class dictionary of industry-related technical vocabulary. Students may add illustrations or diagrams. Each student receives a copy of the final product. Emphasize skills such as alphabetical order, guidewords, prefixes, suffixes, and pronunciation guides.
Read aloud.	Read aloud from workplace materials* in groups or individually.
<i>Identify,</i> Explain symbols, abbreviations and acronyms relevant to subject area.	Using workplace materials*, highlight symbols, abbreviations, and acronyms. Create a table with one column for each of symbols, abbreviations, acronyms. Classify each one and write in the meaning.
Understand, Use rules of grammar, usage, spelling, punctuation.	Identify the missing punctuation mark, misspelled word, incorrect use of grammar from workplace materials*. Correct the mistakes.
<i>Discuss</i> <u>uses and purposes</u> of a variety of workplace communication tools.	Find examples of a business letter, memo, report, brochure, proposal, schematic, map, and diagram.
Duplicate process demo by instructor	Using a workplace process, demonstrate steps

	to complete and have students perform individually or in groups.
<i>Notice,</i> Apply word analysis techniques.	Using workplace materials*, identify prefixes, suffixes, or roots that indicate meaning (e.g. therma = heat) ¹
Match parts from photographs or diagrams to actual objects.	Using workplace materials*, follow a sequence of pictures or diagrams to build, create, or copy an item or process.
Read for main ideas and for details.	Use a graphic organizer ¹ to show main ideas and supporting details.
Distinguish between fact, opinion, and inference.	Collect examples of materials based on fact or opinion/inference. Ask students to underline key terms that indicate the presence of facts or opinions.
Distinguish between rows and columns; identify a cell as a block where a row and column intersect.	Using charts or tables from workplace materials*, discuss the reasons for this format. Identify the quantity in a particular cell.
<i>Select,</i> Use appropriate resources and reference tools.	Explain the uses for the following: Dictionary, Thesaurus, Almanac, Atlas, Card Catalog, Encyclopedia. List reasons for choosing one reference tool over another. Use reference tools to answer questions related to industry or current events.
Paraphrase written or oral material into summary form.	Using workplace materials*, determine the best way to condense or shorten the material so as to give an overview to a layperson. Using a set of guidelines appropriate to students' level in length and detail, summarize the information into bullet points.

<p><i>Interpret,</i> <i>Fill out/complete forms and records.</i></p>	<p>Using workplace materials*, answer basic questions (e.g., summarize the list of parts from an inventory).</p> <p>Using blank forms or documents, fill in details. Pay close attention to directions. Students critique work with partner.</p> <p>Create a form or document to be used in a workplace process.</p>
<p><i>Use,</i> <i>Develop a process for remembering details.</i></p>	<p>Use pneumatic devices to organize and remember details. Pneumatic devices¹ include Semantic Maps, Thought Webs, and other creative tools to organize thinking.</p>
<p><i>Proofread,</i> <i>Correct mistakes in written drafts.</i></p>	<p>Using a newspaper article, locate and mark mistakes in grammar, punctuation, or usage.</p> <p>Correct mistakes in written drafts.</p>
<p><i>Examine different types of writing used in the workplace (reports, memos, brochures, logs, blueprints, formulas, etc).</i></p>	<p>Gather samples of workplace materials*. Identify each by type.</p> <p>Compare and contrast the difference between audience, (who the document is written for) length, background information/education needed to understand material, level of detail, organization and layout of the document.</p>
<p><i>Understand the writing process.</i></p>	<p>In order to apply the writing process, create a workplace communication tool to be used for a specific purpose.</p> <p>Prewrite: Brainstorm, gather facts, or do research to create a <u>business letter, memo, report, brochure, proposal, schematic, map, or diagram.</u></p> <p>Identify the audience.</p>

	<p>Determine the purpose of the document.</p> <p>Write: Create a first draft.</p> <p>Revise and Edit: Make changes to ensure accuracy.</p> <p>Look at the writing from a different point of view.</p> <p>Shorten or make more concise where possible.</p> <p>Use white space, bold print and other formatting details to make the document easy-to-read.</p> <p>Publish: Decide on the best format for the final copy (size, type of material, layout, graphics, etc.)</p> <p>Publish the final draft.</p>
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<p><i>Identify,</i> Create sentences of different types.</p>	<p>Using workplace materials*, find sentences of varying types. Examples include Simple Sentences (subject + predicate) Complex Sentences (subject + predicate including clauses).</p> <p>Write sentences, paragraphs, or essays using sentences of different types (e.g., write a 2-paragraph summary of today's lesson).</p>
<p><i>Identify,</i> Use contractions correctly.</p>	<p>Using workplace materials*, locate contractions (e.g., isn't, I'll).</p> <p>Identify misuses of contractions.</p> <p>Write a short list of directions relating to an industry process and use as many contractions as possible.</p>
<p><i>Identify,</i> Use correctly commonly misspelled words.</p>	<p>Using a list of commonly misspelled words¹, locate errors in the media (newspaper articles, Internet sites, magazines.)</p> <p>Ask each student to identify his problem words from the list.</p> <p>Attempt to incorporate problem words into class activities (e.g., add them to a list of work instructions).</p> <p>Give short weekly quizzes focusing on 5 words per week. Award bonus points.</p>
<p><i>Identify,</i> Use correctly the English irregular verbs.</p>	<p>From a list of irregular verbs, review the uses of each.</p> <p>Ask each student to identify his problem irregular verbs from the list.</p> <p>Attempt to incorporate problem verbs into class activities, such as making a collection of mistakes from print.</p>
<p><i>Identify,</i> Use Signal Words and other cues to improve writing.</p>	<p>Use a list of Signal Words¹ and discuss their purpose in writing (signal words are words that raise a flag to a reader to pay attention.)</p>

	<p>Examples: Signal Words showing emphasis: Most of all, It should be noted, Of course</p> <p>Signal Words showing a conclusion: Lastly, In summary, Finally</p> <p>Identify common signal words in workplace writing, especially in sequenced lists.</p> <p>Write a list of work instructions using signal words.</p>
Identify components of workplace documents such as blueprints, schematics, floor plans, and other industry-related documents.	Label the parts of a workplace document.
Place steps in proper sequence.	Using a list of steps or pictures cut them apart so that students can place them in the proper order.
Analyze cause and effect.	Experiment with cause and effect in the classroom (e.g., change the sequence of events in a process).
Determine missing information.	<p>Locate the information that is missing from a problem and explain why the problem cannot be solved without it.</p> <p>To reinforce concepts, use a completed problem and remove the important details. Ask students if they can identify what's missing.</p>
Differentiate between tools used for a job.	Given a list of tools and a list of functions, identify the most efficient tool for each task.
Assemble or disassemble objects.	<p>From a list of oral or written instructions, assemble an object or complete a process.</p> <p>Students write the instructions for disassembly.</p>
Cross-reference materials to compare information.	Using more than one source document, compare the information given.

<i>Interpret reasoning behind rules or regulations.</i>	Using workplace materials*, make a list of possible reasons or justifications for a safety guideline, regulation, etc.
<i>Show contrasts between approaches.</i>	Given a workplace scenario, write a brief approach to solving the problem. (Working in groups would be beneficial.) Compare and contrast each approach from the perspective of a worker, manager, supervisor.
<i>Organize data in a new format.</i>	Using workplace materials*, organize the information into a new format.
<i>Prove a rule or method's sufficiency.</i>	Perform an experiment to determine how much tolerance is acceptable in a case study, (e.g., find the range of drops of red dye sufficient to match the standard red color used in latex paint).
<i>Show relationships between two or more systems.</i>	Using 2 or more partners related to industry, show or explain how they are interrelated (e.g., explain the relationship between social workers and hospitals).
<i>Given examples of emergency situations, identify real world course of action.</i>	Using an emergency situation common to your industry, outline a step-by-step plan for action.
<i>Identify variables that affect the outcome of a process.</i>	Experiment with or predict variables that affect the outcomes for a process (e.g., weather patterns that adversely affect a process, such as building a road).
<i>Infer situations that meet guidelines when complete information is not available.</i>	Given a policy or industry standard that has debatable interpretations, list possible situations that can arise that do not have clear solutions in the policy. Discuss or debate the issues.
<i>Compare finished products to a set of guidelines.</i>	Compare a set of objects to a set of guidelines (e.g., analyze a batch of parts and document how they do or do not meet a set of Quality Assurance guidelines).

	List any discrepancies (parts that do not meet guidelines) and categorize them by type (e.g., burns, holes, etc).
Identify preventative measures for maintenance of a system.	List the needed routine maintenance to keep a system working properly.
Predict new standards or rules that may become necessary in the future.	Identify recent areas of change or development in your industry. Discuss potential future needs or developments that may occur (e.g., potential need for better training requirements for airport personnel).
Improve a process by streamlining (locating waste) or decreasing lost time.	Examine a process in industry in step-by-step detail. Suggest ways to decrease time needed or make the process more efficient. Isolate the cause of failure in a process by performing an experiment.
Prepare a model explaining a concept.	Build, draw, or create a model that explains a concept (e.g., show a need for environmental standards for water or air pollution).

¹ Fry, Edward; Kress, Jacqueline; Fountoukidis, Dona. *Reading Teacher's Book of Lists*, 4th ed. ISBN 0-13-028185-9.

ACADEMIC STANDARDS FOR MATHEMATICS

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Topics Listing

Problem Solving
 Operations and Calculations
 Applications
 Data Analysis and Display

Objectives	Classroom Applications to Industry
<p><i>Present</i> <i>Review and Discuss</i> Master the list of skills employers want for the workplace regarding mathematics.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
PROBLEM SOLVING	
<p><i>Examine</i> Apply problem-solving process.</p>	<p>Define the problem What is being asked? Decide on a type of solution Multi-step or single-step question? Try any of these: Estimate an answer Draw a diagram Find a pattern</p>

	<p> Guess and check Logical Reasoning Make a graph Make an organized list Make a table Solve a simpler problem Use a simulation Work backwards Write an equation </p> <p> Locate information you need Do you have all the components? </p> <p> Get missing information May need to perform some other calculations </p> <p> Calculate Look at the answer. How should the remainder be expressed? </p> <p> Check the solution Is it reasonable? </p>
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OPERATIONS AND CALCULATIONS

<p><i>Read, write, and count numbers.</i></p>	<p>Read and write numbers (especially focus on very large and very small numbers where mistakes are common).</p> <p>Give a weekly quiz asking students to compare and sequence numbers. Example: 0.4445 ___ 0.4455 > or <</p> <p>Put these in order from smallest to largest: 0.66, 0.677, 0.67</p>
<p><i>Round numbers.</i></p>	<p>Discuss your industry's use of decimals.</p> <p>Identify the place values needed to adequately perform a job. For example, a Quality Assurance Technician who works on the line in a manufacturing plant may need to use numbers through the ten-thousandths decimal place.</p>

	Take a series of sample measurements, and round them to the nearest decimal place identified by the instructor.
<i>Estimate numbers.</i>	<p>The skill of making close estimations is tied to understanding accuracy. Discuss real-life situations where estimation is used.</p> <p>Discuss the practice of estimation before calculation. Regular practice in estimating before calculating will teach students where they make errors and will increase their estimation skills.</p> <p>Discuss work situations where estimation skills are required, and possible consequences of making estimation errors (for example, is an estimate appropriate for inventory purposes? For ordering supplies?)</p>
<i>Compute averages.</i>	<p>Discuss averages in general terms. Calculate the average temperature, average rainfall or precipitation, average number of students per class, and other relevant examples.</p> <p>Using workplace materials*, calculate a series of averages. For example:</p> <ul style="list-style-type: none"> • Take 10 different measurements of a piece of pipe using a micrometer. • Compare the measurements. • Find the average of all the measurements. • Compare the average to the smallest and largest measurement. • Discuss the effects on quality...when is an average an acceptable benchmark measurement?
<i>Calculate with whole numbers: perform one-step problems with basic operations.</i>	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of addition, subtraction, multiplication, and division.
<i>Perform problems that require an</i>	Using workplace materials*, make a list of

<p>understanding of the order of operations.</p>	<p>situations or problems that need more than one step to perform them.</p> <p>If the procedures (add, subtract, multiply, divide, etc) are on the same level of importance, such as adding or subtracting, then the order of operations will not impact the way the problem is solved.</p> <p>If a problem requires more than one level of operation to solve (example, dividing and adding), work the problem correctly by performing the division part first and then the addition.</p> <p>Rework the problem using addition first. Compare the answers.</p> <p>Discuss the importance of reasoning skills to verify that an answer makes sense.</p>
<p><i>Understand the relationship between decimals, fractions and percents.</i></p>	<p>Make a table comparing fractions, decimals, and percents.</p>
<p><i>Compute with fractions, decimals, and percents, and show understanding of the relationship between them.</i></p>	<p>Create sample problems using fractions that relate to everyday situations.</p> <ul style="list-style-type: none"> ▪ Poll the class on interesting topics (favorite food). Convert whole numbers to fractions. Votes- Pizza- 10 Salad- 2 BBQ- 8 <p>$10+2+8 = 20$ (recognize denominator value)</p> <p>$\frac{10}{20}$ Pizza $\frac{2}{20}$ Salad $\frac{8}{20}$ BBQ</p> <ul style="list-style-type: none"> ▪ Add the fractions. <p>$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20}$</p> <ul style="list-style-type: none"> ▪ Convert fraction to whole number. (Total answers equal 1 class's worth of answers.)

	$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20} = 1$ <ul style="list-style-type: none"> ▪ Convert fractions to percents. $\frac{10}{20} \text{ means } 10 \text{ divided by } 20 = 0.50$ <p>Move decimal 2 places right. 0.50 = 50%</p> $\frac{2}{20} \text{ means } 2 \text{ divided by } 20 = 0.10$ <p>0.10 = 10%</p> $\frac{8}{20} \text{ means } 8 \text{ divided by } 20 = 0.40$ <p>0.40 = 40%</p> <p>50% + 10% + 40% = 100% Notice the totals add to 100%.</p> <p>So, $\frac{20}{20} = 1 = 100\%$</p> <p>Using workplace materials*, calculate work-related questions using fractions, decimals, and percents.</p> <p>Calculate shipping costs for internet purchases (such as music from amazon.com).</p>
<p>Solve formulas and equations.</p>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of equations.</p> <ul style="list-style-type: none"> ▪ Work left to right ▪ Use order of operations ▪ Place numbers on one side, variables on the other side
<p>Obtain squares and square roots.</p>	<p>Review the methods for calculating squares, square roots, cubes, and cube roots. Use industry-related formulas to demonstrate examples.</p> <p>Compare the difference between the 2 common answers to 3^2 (answer = 9, not 6).</p>

	How would an incorrect value affect the work on the job?
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for length.</i>	Discuss industry measures and terms relating to length.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for mass/weight.</i>	Discuss industry measures and terms relating to mass/weight.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for volume.</i>	Discuss industry measures and terms relating to volume.
<i>Measure with a certain degree of accuracy.</i>	Estimate measurements. Using workplace materials* and tools, take measurements of work-related and classroom items. Depending on ability level, students may measure to the nearest foot, inch, centimeter, etc.
APPLICATIONS	
<i>Solve word problems.</i>	Help students feel more comfortable with word problems by placing simpler problems in word problem form; or take concepts students have already mastered and ask them to write word problems for each other to solve.
<i>Select/apply mathematical formula.</i>	Review a set of math formulas and then a list of sample problems. Decide which formula(s) apply to each problem.
<i>Understand the importance of time in the workplace.</i>	Using workplace materials*, make a list of workplace scenarios that require using time correctly, such as keeping a time card, or heating a liquid solution for 20 minutes.
<i>Recognize components of time systems (clocks and calendars).</i>	AM and PM Leap Year Military time

<p><i>Discuss,</i> <i>Identify,</i> <i>Understand</i> terms relating to measuring time.</p>	<p>Discuss the units of time measurement and time vocabulary: second, minute, hour, day, week, month, year, leap year, fiscal year, quarter, annual, biannual, etc.</p>
<p><i>Understand that time can be expressed in terms of equivalencies.</i></p>	<p>Show the time equivalencies using fractions. For example: $1 \frac{1}{2}$ days = ___ hours</p> $\begin{array}{rcl} 1 \text{ day} & = & 24 \text{ hours} \\ + \frac{1}{2} \text{ day} & = & +12 \text{ hours} \\ \hline 1 \frac{1}{2} \text{ days} & = & 36 \text{ hours} \end{array}$
<p><i>Compute time conversions.</i></p>	<p>Make a table that shows the equivalencies of time units.</p> <p>Compute conversion problems at the appropriate level of difficulty. Examples include:</p> <ul style="list-style-type: none"> • Convert minutes to hours • Convert hours to days • Convert seconds to years.
<p><i>Calculate ratio and proportion.</i></p>	<p>Review fractions when discussing ratio and proportion.</p> <p>Draw common classroom items to scale by finding a conversion rate (1 foot equals 1 inch).</p> <p>Make predictions using ratios. (If each student in class has 3 children, how many children will there be all together? Write the ratios.)</p>
<p><i>Apply geometry principles: Use formulas for measuring shapes of 2 dimensions.</i></p>	<p>Determine the formulas that apply to 2 dimensions: perimeter, area, surface area, etc.</p> <p>Find perimeter of classroom. Discuss perimeter of objects that are not shaped as perfect squares. How does this change the formula for perimeter?</p> <p>Find the area of the tiles on the floor. Find the area of the classroom.</p>

	Review that all areas are expressed in terms of square units (square inches, square miles, etc)
Apply geometry principles: Use formulas for measuring shapes of 3 dimensions.	Review the formulas that apply to 3 dimensions of objects: volume. Find the volume of common objects such as soda cans, pizza boxes, etc. Review that volume is expressed in cubic units. Discuss industry-specific needs for these formulas; for example, find the volume of a tank or silo.
Define terms relating to money.	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles relating to money. For more advanced students, include terms and principles of economics, finance, or statistics.
Perform one-step problems involving money.	Make change. Count up (rather than backwards) to make change.
Perform multiple-step problems using money.	Calculate gross and net earnings. Calculate <ul style="list-style-type: none"> ▪ Interest ▪ Sales tax ▪ Percent off ▪ Sale price ▪ Profit percentages Perform banking transactions.
Perform business-related financial activities.	At a level of complexity appropriate to your industry and to students' ability levels, solve income/expense problems, prepare budgets, etc.
Use a calculator to perform computations.	Identify appropriate activities that can be performed using a calculator (calculators

	<p>allow students to concentrate on problem-solving strategies.</p> <p>Award prizes for weekly activities or competitions.</p>
Calculate measurements taken from measuring devices.	Add, subtract, multiply and divide measurement numbers by plugging them into formulas.
Perform/prepare an inventory.	<p>Use a sample group of items to prepare an inventory.</p> <p>Review inventory vocabulary terms.</p> <p>Discuss the math processes that would apply to the inventory process.</p>
DATA ANALYSIS AND DISPLAY	
Recognize types of visual representations.	<p>Charts</p> <p>Graphs</p> <p>Tables</p>
Interpret charts, graphs and tables.	<p>Answer simple questions about charts, graphs and tables.</p> <p><i>Solve</i> multi-step problems involving the correlation of graphs and tables.</p>
Collect/record data.	<p>As appropriate to industry, practice sampling methods. Discuss safety precautions for sampling. Visit OSHA at the Department of Labor website for more details.</p> <p>Practice collecting and recording sample data from your industry (such as measurements taken using a micrometer). Compare class answers.</p> <p>Find the range of answers (maximum and minimum). Find the average.</p> <p>Discuss an acceptable range of answers (\pm), and graph the results showing the number that fell inside and outside the acceptable range.</p>

<p><i>Review and apply principles of probability.</i></p>	<p>Use real-life examples that are highly motivating to direct the students' attention to probability principles. (Example, "I am thinking of a number between 1 and 50. The person who guesses the number will receive that many bonus points if she can tell me the probability of choosing the number correctly.")</p>
<p>Use probability models to predict chance events.</p>	<p>Calculate <u>theoretical probability</u> of an event (e.g., the probability of rolling a 5 on a die is 1/6).</p> <p>Find <u>empirical probability</u> of an event by performing repeated experiments.</p> <p>Compare the 2 probabilities.</p>
<p><i>Calculate and interpret statistics.</i></p>	<p>Identify the importance of using statistics correctly. Bring examples of statistics from the news or media and analyze them: are they ambiguous? Are they correct? What data is the advertisement trying to get the public to see?</p> <p>For a humorous look at statistics, see <i>How to Lie with Statistics</i> by Huff and Geis.</p>
<p><i>Interpret plans/blueprints.</i></p>	<p>Review vocabulary and terms for plans, blueprints and schematics.</p> <p>Build a plan or blueprint one layer at a time, starting with the basic identifying information.</p> <p>Add layers of wax paper or other transparent drawing material on top of the first layer that allows each layer to be viewed individually, or the entire drawing as a whole.</p>
<p><i>Construct charts and tables.</i></p>	<p>Discuss chart types and chart vocabulary.</p> <p>Using workplace or sample data from the class, construct tables and charts.</p>

	<p>For a daily example, consult <i>USA Today</i> online and look for the snapshots section that shows a graph of some sort. Ask weekly bonus questions about the data.</p>
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Challenge students to bring in examples of charts and graphs containing errors.

ACADEMIC STANDARDS FOR SCIENCE

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Topics Listing

General Science- topics not specific to a content area

Physical Science- Mechanics and Physics
Energy and Waves
Thermodynamics
Electromagnetism
Chemistry
Optics

Life Science- Cell biology
Evolution
Genetics and Heredity
Human and Animal Development

Anatomy Ecology
Viruses
Bacteria
Plants

Earth Science- Earth in space
Solar System/Astronomy
Atmosphere and weather
Oceans and water
Earth resources

Note:

*** indicates industry-related materials, handouts, notes, etc.**

Objective

Classroom Applications to Industry

GENERAL SCIENCE	
<i>Present, Review and Discuss, Master the list of skills employers want for the workplace regarding science skills.</i>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none">• Discussion• Interviewing parents or other adults in the workplace about the skills required• Interviewing employers about the skills in terms of importance• Identifying workplace situations in which certain skills become more important than others• Researching adult education programs to learn why deficits in these areas must be remediated; find out the cost to employers to educate adult workers• Researching the topic of adult literacy
<i>Perform computations as required to solve problems.</i>	<p>Use the metric system to convert units of measure.</p> <p>Round numbers to correct number of significant figures.</p> <p>Determine percentage of error.</p> <p>Understand validity, reliability, accuracy, and precision.</p>
<i>Apply scientific method of inquiry.</i>	<p>Identify the steps of the scientific method.</p> <p>Conduct experiments.</p> <p>Understand the following terminology: Conclusions vs inferences Variables Replications Samples/sample size</p>

<p><i>Investigate science history as it applies to industry.</i></p>	<p>In groups, research topics in science pertaining to your industry. Have students assign roles for each member of the group.</p> <p>Present findings in report format, or in oral presentations.</p> <p>Investigate science ethics.</p> <p>Recognize the processes available for accountability in industry. For example, OSHA has a Safety and Health Program Assessment Worksheet whereby employers can be rated for safety issues. See http://www.osha.gov/SLTC/safetyhealth_ecat/mo d3.htm</p> <p>[Note: Safety and Health is a mandatory subject of bargaining when a workplace is unionized; in both unionized and non-unionized workplaces, an employer cannot create and dominate workplace safety committees (see the National Labor Relations Act).]</p>
<p><i>Use scientific instruments to measure aspects of the environment.</i></p>	<p>Gather data on time, length, mass, pressure, volume, acceleration or other measureables using instruments from the job.</p>
<p><i>Demonstrate an understanding of data.</i></p>	<p>List the processes involved in gathering data.</p> <p>Suggest ways that data can be grouped or organized.</p> <p>Collect specimens.</p> <p>Show how data can be represented (graphically, charts and diagrams, etc)</p> <p>Construct a model to depict a basic concept.</p>
<p><i>Identify the seven basic S I (Systeme International) units.</i></p>	<p>Length- meter- m Mass- kilogram- kg Time- second- s Electric current- ampere- A</p>

	<p>Temperature- Kelvin- K Amount of substance- mole- mol Luminous intensity- candela- cd</p> <p>Dictionary of units- see http://www.ex.ac.uk/cimt/dictunit/dictunit.htm</p>
Identify S I (Systeme International) Derived units.	<p>Choose units appropriate to your industry (hertz, ohm, volt, watt, etc).</p> <p>Create a picture dictionary demonstrating the concepts.</p>
Review relevant theories, laws and models.	<p>As relating to your industry, discuss important theories, laws and models.</p>
Use reference tools to solve problems.	<p>Use scientific reference tools (such as the Periodic Table of Elements) to learn more about specific industry concepts.</p>
Practice safe lab procedures.	<p>Handle equipment with care.</p> <p>Demonstrate safety and first aid procedures.</p> <p>Identify harmful substances.</p>
PHYSICAL SCIENCE	
Understand the cyclical nature of systems.	<p>Show, demonstrate, model, track the cycles of any of the following systems: Growth and decay Food webs Weather Water</p>
Analyze/classify matter according to type.	<p>Identify types of matter (solids, liquids, gases). Which types are predominantly used in your area of industry?</p>
Explain the concepts of work and power.	<p>Identify machines used in industry.</p> <p>Identify how energy levels change when work or power is increased/decreased.</p> <p>Identify fuel sources used in your industry.</p> <p>Discuss internal and external combustion.</p>

	Create a model demonstrating the uses of levers and pulleys.
<i>Be familiar with concepts of motion.</i>	<p>Measure acceleration and deceleration</p> <p>Understand the relationship between speed and velocity by performing experiments.</p> <p>Recognize waves and vibrations as a type of motion.</p> <p>Understand action and reaction.</p> <p>Review laws pertaining to motion.</p>
<i>Understand concepts related to force.</i>	<p>Show the need for balance of forces acting on an object.</p> <p>Observe centrifugal and centripetal forces in action.</p> <p>Show how friction is created and must be accounted for in using and preserving equipment.</p> <p>Create a chart showing types of lubricants needed in a factory and schedule of maintenance.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of inertia.</p> <p>Show the relationship between pressure, mass, and weight.</p>
<i>Understand and apply principles relating to the atom.</i>	<p>Understand that atoms have a positive, negative or neutral charge. (Classify protons, electrons, and neutrons.)</p> <p>Identify ions.</p>
<i>Investigate forms of and changes in energy.</i>	<p>Discuss how energy is measured.</p> <p>Observe changes in energy relationships.</p> <p>Identify catalysts and reactants.</p>

	<p>Identify sources of kinetic and potential energy in your industry.</p>
<p><i>Discuss, apply principles of electricity and electric currents.</i></p>	<p>Identify types of circuits and switches.</p> <p>Show the difference between direct and alternating currents. Give examples of the best/most efficient use of each.</p> <p>Determine how electricity is measured, and solve problems using these terms. (Example, use Ohm's law to calculate current, resistance, and voltage.)</p> <p>Identify good conductors and insulators, and how to choose them.</p> <p>Understand grounding and create a visual display of grounding safety practices. Include the threat of static electricity.</p> <p>Show the uses of a vacuum tube by building a model.</p> <p>Compare the following ways of generating electricity: Hydroelectricity Motors Solar Power Steam/nuclear Transformers Incandescent (Light) Show the implications for your industry.</p> <p>As appropriate to your industry, identify electrochemical energy sources (cells, electrodes, batteries) and the processes of oxidation and reduction.</p>
<p><i>Be familiar with sound waves.</i></p>	<p>Compare how sound waves travel between liquids, solids, and air.</p> <p>Examine different types (lengths) of sound waves. Examine decibels safe for human hearing. Identify safety precautions for industry regarding sound tolerance.</p>

	<p>Be able to use correctly the terms below as they relate to your industry. (For example, ask students to write a short essay explaining a demonstration from class and include the following terms):</p> <p>Amplification Audible range Frequency Acoustics Resonance Speed</p>
<i>Be familiar with principles of heat.</i>	<p>Differentiate between the 3 types of heat transfer (conduction, convection, radiation).</p> <p>Understand that substances expand and contract due to heating and cooling</p> <p>Identify purpose and types of insulations used.</p> <p>Differentiate between heat and temperature.</p>
<i>Investigate and apply concepts relating to temperature.</i>	<p>Use the temperature scales; convert between Celsius and Fahrenheit.</p>
<i>Explain the concepts of magnetism.</i>	<p>Understand that currents create magnetic fields.</p> <p>Identify materials that are good conductors, and the properties that make them such.</p> <p>Understand electromagnetic forces present in earth.</p>
<i>Investigate/apply chemical properties.</i>	<p>Differentiate between acids and bases. Find pH for substances used in industry.</p> <p>Identify substances used in your industry and classify them by type.</p> <p>Name the major drugs, fertilizers, or additives used in your industry. Define and state examples of chemical reactions.</p> <p>Be familiar with solutions used in your industry. Compare saturated and unsaturated solutions. Determine whether a solution is soluble or insoluble.</p>

	Explain solute and solvent.
<i>Investigate forms of and changes in matter.</i>	<p>Compare and contrast physical and chemical changes.</p> <p>Discuss the types of physical or chemical changes that take place in your industry, from processing raw materials to manufacturing.</p>
<i>Understand and apply concepts relating to the elements.</i>	<p>Examine the 4 elements that make up 99% of living organisms (Hydrogen (H), Oxygen (O), Nitrogen (N), and Carbon (C)).</p> <p>Element Groups: Alkali Metals Alkaline Earth Metals Transition Metals Other Metals Metalloids Non-Metals Halogens Noble Gases Rare Earth Elements</p>
<i>Be familiar with principles of light.</i>	<p>Discuss light as a form of energy.</p> <p>Describe types of lighting systems.</p> <p>Examine the light spectrum and note the relative smallness of visible light.</p> <p>Define reflection and refraction.</p> <p>Explain how light carries information (by lasers) and show examples of the impact on technology/industry.</p> <p>Identify types of lenses.</p>
<i>Be familiar with principles of color.</i>	<p>Diagram the main parts of the eye involved in seeing color (rods, cones).</p> <p>Use prisms to split light into the visible spectrum. Briefly explore color blindness. What precautions should colorblind persons take regarding workplace safety?</p>

	Define situations in which colorblindness impacts a worker's ability to do his job.
LIFE SCIENCE	
<i>Explain the presence of cells as the identifier of all living organisms.</i>	<p>Examine the cells of organic material used in your industry, using books, the internet, or a microscope.</p> <p>Recognize that cells divide or replicate to promote growth of an organism.</p> <p>Examine the parts of a cell. Compare the cell to a machine...how do the parts function and rely on each other?</p> <p>Give example of one-celled and multiple-celled organisms.</p> <p>Review the classification system of all organisms (Kingdom, Phylum, etc).</p> <p>Create a circle graph or pie chart (totaling 100%) showing the relationship (in numbers) between the groups of organisms: Bacteria Fungi Viruses Insects Plants Vertebrates Invertebrates</p> <p>Compare some of the cell processes (active and passive transport) to the processes in your industry.</p>
<i>Understand the progress of evolution of organisms.</i>	Recognize how a species will adapt to better fit in its environment over time.
<i>Explain the role of genetics in human development.</i>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of heredity, including:</p> <ul style="list-style-type: none"> • Half of an individual's genes are contributed by each parent • Traits that are inherited are either dominant or recessive from the parent(s)

	<ul style="list-style-type: none"> • Cell division by mitosis versus meiosis • Disabilities are caused either by genetic/inherited conditions (such as Down's Syndrome) or in accidents occurring after birth, such as brain damage due to a car accident or a stroke
<i>Investigate/apply</i> principles of human development.	<p>Describe the life cycle of humans and other animals.</p> <p>Use the concept of human development to explain the need for understanding foundation skills in your area. (For example, children do not run before they walk.) Use this concept to explain other events that occur in a natural order in your industry.</p>
<i>Explore</i> additional concepts pertaining to humans and other animals.	<p>Give examples of ways organisms adapt to their environment.</p> <p>As relating to industry, review the concepts of:</p> <p>Aging Immune system Skin and Tissues Blood and hemoglobin Disease</p>
<i>Compare/contrast</i> the differences between sexual and asexual reproduction.	<p>Determine instances when understanding the concepts of sexual reproduction are important for your industry.</p> <p>Highlight the effects of unsafe working practices on unborn fetuses, or the dangers present for pregnant individuals working in industry.</p>
<i>Show</i> a general understanding of the importance of health.	<p>Explore the cost of lost wages and worker's compensation in the past year due to health problems.</p> <p>Research the most common health problems among workers (workers with safe jobs; workers with most hazards to health, etc)</p>
<i>Investigate</i> the food cycle.	<p>Identify food chains, food webs, food pyramids.</p> <p>Show how changes to the food cycle affect the</p>

	<p>environment and affect man.</p> <p>Name the food groups.</p>
<p><i>Understand</i> nutrition and the body's need for a diet that provides vitamins and minerals.</p>	<p>Show an understanding of body systems (circulatory, nervous, digestive, etc) as they relate to industry.</p> <p>Identify deficient vitamins and minerals among a particular population (American workers, workers in specific environments, workers who do not go outdoors, or who always work outdoors) and the health risks associated with job types (office work, mining work, etc.)</p>
<p><i>Observe</i> health code/sanitation requirements.</p>	<p>Research the development of health code and sanitation requirements, including OSHA.</p> <p>Compare/contrast workplaces of 1850, 1900, 1950, 2000 regarding health and safety.</p> <p>Discuss the most common workplace violations of health requirements and present in a graphic format (e.g., maps, charts).</p> <p>Discuss potential effects of ignoring health requirements.</p> <p>After identifying workplace hazards, create several plans to treat the problem. Debate the benefits of each.</p> <p>To avoid the threat of employers choosing ineffective means of ensuring safety on the job, locate MSDS sheets, first aid stations, personal protective equipment, worker's compensation claims offices/paperwork, etc.</p> <p>Using workplace materials*, locate the section on safety regulations. Ask students to rank order the items. Debate the importance of each. Determine the threat of ignoring regulations. Research which regulations are often disregarded.</p> <p>Explore proactive measures students can take to extend their health.</p> <p>Understand the importance of mental health in</p>

	addition to physical health.
<i>Investigate/apply</i> principles of anatomy and physiology.	<p>As relating to your industry, explore issues relating to anatomy and physiology.</p> <p>Skeletal system- study the bones of the arm, hand, and neck. Research carpal-tunnel syndrome.</p> <p>Fractures- identify the types of fractures and those most common to your line of work. Learn how to prevent falls.</p>
<i>Understand</i> basic principles of Ecology.	<p>Define ecology.</p> <p>Identify 5 major ways in which man interacts with the environment, especially as relating to your industry.</p> <p>Discuss the effectiveness of the media as compared to pro-science groups (such as Greenpeace) on the public's awareness of important environmental issues.</p> <p>Identify any areas of concern regarding waste/waste management in your industry.</p> <p>Show the difference between a niche, community, habitat, and ecosystem.</p> <p>Give examples of herbivores, carnivores, and omnivores. How does your industry use and serve each group?</p> <p>Understand predators' effects on food chains. Identify predators of industry.</p> <p>Explain the process of decomposition and decay. How does industry interfere with or interrupt these processes?</p>
<i>State</i> the differences between viruses and bacteria.	<p>Define viruses and bacteria.</p> <p>Explore viral and bacterial threats present in the workplace. How can they be prevented? How can they be treated?</p> <p>State the benefits of viruses and bacteria.</p>

	Explain the recent increased resistance to drugs and antibiotics.
<i>Understand</i> basic concepts relating to plants.	Describe the interchange of oxygen and carbon dioxide between plants. Contrast to the way humans exchange oxygen and carbon dioxide. As relating to industry, review the concepts of: Fertilization Parts of plant, and functions of each Effects of temperature on plants Need for water and light Photosynthesis
EARTH SCIENCE	
<i>Recognize</i> earth's position in the universe.	As relating to your industry, identify relevant topics regarding Asteroids Comets Stars Galaxies Identify planets in the solar system. Compare and contrast earth to other planets. Create a model showing the relative size of earth within our solar system. Use mathematical relationships to make sure the scale is correct (earth is the size of ___ so the sun should be the size of ___). How do the phases of the moon and sun affect the hemispheres?
<i>Investigate</i> history of the earth.	Identify geological, chemical and other methods of determining the age of an object. Demonstrate that fossils and rocks are indicators of previous eras. As a class, create a timeline indicating the age of the earth. Include the various ages (Ice Age, etc) and the length of each. Make sure the timeline is drawn to scale.

	<p>Assign each Age to a group and research the following:</p> <p>Weather</p> <p>Major events at beginning and end of age</p> <p>Organisms living during this time</p> <p>Factors that made the Age unique</p>
<i>Investigate physical characteristics of the earth.</i>	<p>Label/model the components of the earth.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of gravity.</p> <p>Solve problems of longitude, latitude and time zones.</p> <p>Create a model of the ratio of land and water on earth.</p>
<i>Investigate physical forces acting on the earth.</i>	<p>Examine erosion and depletion of nonrenewable resources.</p> <p>Identify natural disasters such as hurricanes and earthquakes. Research the effects of a past disaster on a specific industry.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of plate tectonics (the earth's surface is broken into large plates; movements of these plates over time causes earthquakes and other geologic activity).</p>
<i>Explain the basic components of earth's rotation.</i>	<p>Understand that the earth spins on its axis at an angle of 23 ½ degrees</p> <p>Identify the period of one complete rotation as a day; longer cycles of rotations identify the seasons.</p> <p>Discuss time zones.</p>
<i>Identify the earth's atmosphere and its components.</i>	<p>Identify the main elements in the earth's atmosphere (nitrogen and oxygen).</p> <p>Identify layers of the atmosphere, and the ozone layer.</p>

	Explain concepts of air pressure.
<i>Understand</i> basic principles of the solar system.	Demonstrate how the sun strikes the earth at different angles depending on location.
<i>Demonstrate</i> the relationship between climate and weather.	<p>Identify the factors that create weather.</p> <p>Show how landscape features are affected by changes in climate or weather.</p> <p>Identify the greenhouse effect. How does industry contribute to it?</p> <p>Describe the relationship between altitude and weather.</p> <p>Understand that changes in the weather may be seen as fronts that are put in motion by the jet stream.</p> <p>Identify types of precipitation.</p> <p>Differentiate between types of clouds.</p> <p>Understand the effect of winds, wind speeds, and impacts on vegetation.</p>
<i>Learn and apply</i> concepts relating to the oceans.	<p>Label the major oceans and seas.</p> <p>Determine the elements in ocean water (nearly all elements are present).</p> <p>Identify or draw the structural components of the ocean floor.</p> <p>Explain the relationship between the moon and the tides.</p> <p>Explore ways the ocean is used for power and business.</p>
<i>Investigate</i> principles of water.	<p>Identify the parts of the water cycle and the effects of the processes involved.</p> <p>Define water's chemical properties water is the universal solvent water has a neutral ph of 7</p>

	<p>chemically, water is one atom of oxygen bound to two atoms of hydrogen)</p> <p>Measure salinity. Which industries rely heavily on water?</p> <p>Define water's physical properties water is the only natural substance that exists as solid, liquid, and gas water's surface has a high density water has a high tolerance for heat (heat index) water's weight water as a coolant specific gravity</p>
<i>Investigate conservation of physical and natural resources.</i>	<p>As relating to your industry, discuss or debate the issues of Allocation of resources Recovering resources Best/worst methods of using resources</p> <p>Compare/contrast renewable and nonrenewable resources.</p> <p>Note the important developments in your industry regarding mineral, soil, water, and wildlife conservation.</p> <p>Discuss alternative sources of energy as relating to your industry.</p>
<i>Investigate issues regarding scientific technology.</i>	<p>As relating to your industry, discuss the uses of technology. What are the newest developments?</p> <p>What effects does the technology have on our society? Political system?</p> <p>Discuss the role of economics on technology.</p>
<i>Apply science principles/laws to environmental issues.</i>	<p>Discuss how mankind alters the earth and environment through use of resources and technology, pollution.</p>

Crosswalk to SkillsUSA

Electronic

SkillsUSA, the co-curricular student organization for Trade and Industrial Education, provides many opportunities through its program of work for students to apply the knowledge, skills, and processes learned in a variety of courses. A correlation of the Electronic Technology technical contest to selected tasks/competencies in Arkansas's Electronics courses are provided as a supplement to this framework.

Purpose

To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of electronics technology.

Clothing Requirement

For men: Official SkillsUSA white polo shirt with black dress slacks, black socks and black leather shoes.

For women: Official SkillsUSA white polo shirt with black dress slacks or skirt, black socks or black or clear seamless hose and black leather shoes.

All: Safety glasses with side shields or goggles. (Prescription glasses can be used only if they are equipped with side shields. If not, they must be covered with goggles.) To purchase the polo shirt, contact Midwest Trophy Manufacturing Co. Inc. by calling 1-800-324-5996 or order online at: <http://www.mwtrophy.com/vica/index.html>.

Eligibility

Open to active SkillsUSA members enrolled in programs with industrial electronics or electronics technology as the occupational objective.

Equipment and Materials

- Supplied by the technical committee:
 - All materials, supplies and job information needed to construct and test the designed circuit

- All necessary information and furnishings for judges and technical committee
- Supplied by the contestant:
 - Small pliers
 - Wire cutter
 - Wire stripper for #28 and #30 gauge wire
 - Small-assorted screwdriver set (Phillips and slotted)
 - 25-watt soldering iron and associated soldering supplies (Note: No soldering guns allowed)
 - Pocket calculator with no preprogrammed formulas
 - Other hand tools as desired, subject to the approval of the technical committee
 - Portable VM/VOM Multimeter*
 - 20 or more MHZ dual trace oscilloscope*
 - Three 10x probes
 - Calculators (can have scientific notation, but cannot be programmable)

*May be supplied by technical committee. Check April 1 Update annually..184 *SkillsUSA Championships Technical Standards (2002–2004)*

Scope

- Analyze and measure AC signals using oscilloscope, frequency meters and generators
- Analyze, construct and troubleshoot AC capacitive circuits, AC inductive circuits, RLC circuits (Series, Parallel, Complex) series and parallel resonant circuits, filter circuits and polyphase circuits
- Analyze basic motor theory and operation 7. Analyze basic generator theory and operation
- Set up and operate VOM, DVM and power supplies for AC circuits
- Set up and operate oscilloscopes, frequency counters, signal generators, capacitor-inductor analyzers and impedance bridges for AC circuits
- Analyze and apply principles of transformers to AC circuits
- Solid State Devices
 - Identify properties of semiconductor materials
 - Analyze and measure characteristics of P-N junction diodes

- Analyze and measure characteristics of special diodes
- Analyze, construct and troubleshoot diode circuits
- Identify, define and measure characteristics of bipolar transistors, thyristors and integrated circuits
- Set up and operate VOM, DVM, and power supplies for solid-state devices
- Set up and operate oscilloscopes, frequency counters, signal generators, capacitor-inductor analyzers and impedance bridges for solid state devices
- Set up and operate curve tracers and transistor testers
- Analog Circuits
 - Analyze, construct and troubleshoot single stage amplifiers, multi-state amplifiers, basic power supplies and filters, power supply regulators, active filters, and oscillators
 - Analyze motor or phase control circuits
 - Set up and operate VOM, DVM and power supplies for analog circuits
 - Set up and operate oscilloscopes, frequency counters, signal generators, and capacitor-inductor analyzers for analog circuits
 - Set up and operate impedance bridges for analog circuits
 - Set up and operate recorders for analog circuits
- Digital Devices
 - Define and apply number systems to codes and arithmetic
 - Analyze, construct and troubleshoot logic gates, logic arithmetic circuits, flip-flops, and encoders and decoders
 - Identify, define and measure characteristics of IC logic families
 - Analyze, construct and troubleshoot registers and counters, clock and timing circuits, multiplexers and demultiplexers, and digital to analog and analog to digital
 - Analyze, construct and troubleshoot displays and representative digital systems
 - Set up and operate VOM, DVM and logic probes for digital devices
 - Set up and operate power supplies, pulsers, oscilloscopes, logic analyzers, signature analyzers, pulse generators and counters for digital devices
- Micro processing

- Analyze, construct and troubleshoot CPUs, BUS systems, memory systems, and input/output ports, microprocessor applications and systems
- Execute computer instruction sets Analyze and troubleshoot microcomputer systems
- Set up and operate VOM, DVM, logic probes, power supplies, pulsers, oscilloscopes, logic/data analyzers, signature analyzers, pulse generators and counters for micro processing

Lab Practices

- Demonstrate proper safety standards
- Make electrical connections
- Identify and use hand and power tools properly
- A written test will be supervised by ISCET.
- Contestants will be provided with the characteristics, parameters, and necessary information required to accomplish the assigned task.
- Time limit
 - Contestants will begin upon a signal from the timekeeper
 - As soon as contestants have completed the assignment and are fully satisfied with the operation and quality of their work, they will signal the judge and stop work. This signal will determine elapsed time and speed.
- The completed projects will be tested by the judges for quality of work and operating specifications. *Sponsored by Goodheart-Willcox Publisher 185*

Items Evaluated

(Points will be assigned by technical committee based on the difficulty of the project)

Quality of Product

Fabrication

Bread Board

Locating Malfunctions

Component Identification

Design

Written Test

Final Operation and Test of Product

Completion of Project within Assigned Time

SUBTOTAL

CLOTHING PENALTY (minus 0 to 5 percent of total possible points)

TOTAL

Note: An Oral Professional Assessment will be included. Points to be determined by national technical committee..186 *SkillsUSA Championships Technical Standards (2002– 2004)*.

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Arkansas's All Aspects of Industry

Defining “All Aspects”

All aspects of an industry include, with respect to a particular industry that a student is preparing to enter, planning, management, finance, technical and production skills, underlying principles of technology, labor and community issues, health and safety, and environmental issues related to that industry. Planning is examined at the level of both an individual business and the overall industry. Planning elements might include:

- Developing strategic plans — mission, vision, goals, objectives, and/or a plan of action
- Working with planning tools such as surveys, market research, and competitive analysis
- Anticipating needs for staffing and major purchases of equipment and supplies
- Developing plans for training and upgrading of staff
- Forecasting market trends
- Developing business plans for entrepreneurial ventures.

Management addresses methods typically used to manage enterprises over time within the industry, as well as methods for expanding and diversifying workers' tasks and broadening worker involvement in decisions. Key elements of management might include:

- Using an organization chart to explain how a corporate chain of command works
- Providing input for strategic plans and communicating the company's vision and mission statements
- Leading employees in carrying out strategic plans and action plans
- Evaluating employee performance
- Anticipating technology and other major purchasing needs
- Ensuring equity and access for employees
- Resolving conflicts
- Developing job descriptions and written policies/procedures
- Identifying recruitment procedures, training opportunities, methods of evaluation, and retention strategies
- Working with professional associations and community outreach efforts.

Finance examines ongoing accounting and financial decisions and different methods for raising capital to start or expand enterprises. Finance functions might include:

- Developing budgets
- Preparing financial statements
- Analyzing and managing financial transactions and records
- Implementing payroll procedures
- Determining and paying taxes
- Identifying indirect wage costs (benefits, FICA, insurance, worker's compensation)
- Making loans and granting credit to customers
- Developing graphs and charts related to company finances
- Identifying and implementing methods of sustaining profitability of a business
- Managing 401K plans
- Identifying sources of capital

Technical and Production Skills cover specific production techniques and alternative methods for organizing the production work, including methods that diversify and rotate workers' jobs. Technical and production skills that an employee should have to succeed in a business or industry might include:

- Developing and upgrading job-specific skills
- Using troubleshooting and problem-solving techniques
- Analyzing information to make decisions
- Identifying and implementing quality assurance techniques
- Employing communication skills such as writing, listening, speaking, and reading
- Participating in team efforts
- Implementing projects and new techniques
- Demonstrating basic computer skills; employing time management techniques in completing projects and assigned tasks
- Demonstrating ethical behavior and work ethic.

Underlying Principles of Technology provide an integrated study across the curriculum of the mathematical, scientific, social, and economic principles that underlie the industry's technology.

Principles of technology that an employee should know might be demonstrated by:

- Exhibiting proficiency in mathematical and scientific functions related to new and emerging technologies
- Continuously upgrading job skills needed to implement new technologies
- Participating in industry certification programs
- Cross-training to enhance one's value to the organization and to enhance job promotion opportunities
- Understanding and adhering to ethical issues related to technologies.

Labor Issues examine worker rights and responsibilities, labor unions and labor history, and methods for expanding workers' roles. Labor issues might include:

- Understanding and implementing worker rights and responsibilities
- Working with labor unions
- Keeping abreast of local, state, and federal legislation affecting employee and employer rights and responsibilities
- Negotiating and settling worker disputes
- Identifying certification requirements for specific jobs
- Analyzing the impact of labor agreements on business operations.

Community Issues explore the impact of the industry on the community and the community's impact on and involvement with the industry. Concepts of business and community relations might include:

- Developing and working with community outreach projects
- Participating on advisory committees and community organizations
- Working with professional associations
- Developing and implementing public relations plans
- Participating in community service projects.

Health, Safety, and Environmental Issues examine these concepts in relation to both the workers and the larger community. Concepts related to health, safety, and the environment might include:

- Identifying and implementing federal, state, and local regulations related to the health and safety of employees
- Understanding and strictly adhering to federal, state, and local environmental regulations related to the business
- Identifying job-specific health hazards and safety issues
- Identifying and implementing basic safety and first aid training techniques for emergencies such as personal illness or injury, tornadoes, fires, nuclear accidents, floods, and incidences of employee-rape or violent behavior
- Communicating safety regulations and plans to employees

Working with selected community groups to implement safety programs.

Electronics

Framework Cross Reference

Electronics I

Unit 1	General Skills	Duty(s): A,B
Unit 2	DC Circuits	Duty(s): C,D
Unit 3	AC Circuits	Duty(s): E
Unit 4	Customer Relations	Duty(s): B
Unit 5	The VICA Student Organization	Duty(s): A,B

Electronics II

Unit 1	Discrete Solid State Circuits	Duty(s):
Unit 2	Analog Circuits	Duty(s): F
Unit 3	Digital Circuits	Duty(s): G
Unit 4	Microprocessors	Duty(s): H
Unit 5	Microcomputers	Duty(s): H
Unit 6	Customer Relations	Duty(s): B
Unit 7	The VICA Student Organization	Duty(s): A,B