

**Technical and Professional
Education**

**Curriculum Content Frameworks for
Furniture Manufacturing
Technology**

**Instructional Frameworks for
Furniture Manufacturing Technology
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 Wood Manufacturing 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.

Foreword

The curriculum content framework Furniture Manufacturing Technology 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 Wood Manufacturing Industry.

- Career Family: Production
- Career Role CIP Code – 48.0702 Furniture Designer and Maker
- O-NET – 51-7042.02 Woodworking Machine Operator and Tender, 51-7021.00 Furniture Finisher, 51-7042.01 Woodworking Machine Setters and Set-up Operators, 51-7011.00 Cabinetmaker and Bench Carpenter

Acknowledgments

The Furniture Manufacturing Technology curriculum content framework was produced by a team of program developers from the University of Arkansas at Little Rock and representatives from industry and education. A panel of experts in the field of wood manufacturing reviewed the framework. The format and content of the framework reflect the specific training needs within the state of Arkansas. The framework format is modeled after a document originally developed by a writing team under the auspices of the Virginia Department of Education. Grateful appreciation is expressed to the Virginia Department of Education for granting the Arkansas State Department of Workforce Education access to its instructional frameworks.

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Introduction

About the Program

Furniture Manufacturing Technology I & II prepares students for careers in the wood industry. The course sequence focuses on duties and tasks performed by professionals in a variety of jobs.

About the Document

- Section 1 contains a master duty/task list for the Furniture Manufacturing Technology 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 Furniture Manufacturing program.
- Section 3 lists the Arkansas Standards of Learning for language arts, mathematics, and science that are reinforced by instruction in the Furniture Manufacturing program. Academic skills in these areas are necessary for the mastery of a number of tasks performed by wood technicians on the job.

Course Descriptions

494850 – Furniture Manufacturing I

494870 – Furniture Manufacturing II

494860 – Furniture Manufacturing Lab

This program introduces principles of design, wood selection, cutting, assembling, and finishing wooden furniture. Instruction includes: awareness of careers related to the wood manufacturing industry, basic design principles, safety procedures, sketching, laying out, and preparing stock. Each student will assemble and finish a useful furniture piece as a required individual project.

Master Duty/Tasks Listing
Furniture Manufacturing Technology
Furniture Manufacturing I
Furniture Manufacturing II

National and state experts in the occupational field of wood manufacturing 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

INDUSTRY SPECIFIC THEORY
DUTY A:
Trees
Task:
A001: Discuss a structural diagram of a tree
A002: Explain the functions of different parts of a tree
A003: Name and identify conifers and broad leaf species
A004: Explain processes and functions of a tree on the microscopic level, such as photo synthesis, movement of water, etc.
DUTY B:
Forestry
Task:
B001: Identify major forest regions in the United States
B002: Discuss local forest regions and their impact on local economies
B003: Practice forest measurements on a short timber cruise
B004: Discuss forest protection (fires, insects, and diseases)
DUTY C:
Environmental Issues
Task:
C001: Discuss the issue of protecting forests (local forest, rain forests, etc.)

C002: Explain the term “sustainable forestry” and view video by Patrick Moore
C003: Explain the terms “selective cutting” and “clear cutting” and their applications
C004: Discuss current environmental issues, such as the Kyoto Protocol, global warming, depletion of the ozone layer, etc.
DUTY D: Lumber and Lumber Grading
Task:
D001: Collect and identify samples of various wood species
D002: List the working characteristics of various wood species
D003: List natural defects in wood
D004: Name grades of softwood lumber
D005: Name grades of hardwood lumber
D006: List different sawing patterns for lumber and their preferred use
D007: Identify the commercial value of various wood species in different lumber grades
DUTY E: Wood Moisture Relationship and Lumber Drying
Task:
E001: Explain the term “relative humidity” as it relates to lumber
E002: Explain the transport of water in lumber
E003: Describe the process of shrinkage and swelling in wood
E004: Describe problems caused by wood moisture in manufacturing wood products

E005: Measure the moisture content of different wood samples using a moisture meter
E006: Measure wood movements under changing climatic conditions
E007: Describe ideal conditions for storing lumber
E008: List methods of drying lumber
E009: Explain the process of drying lumber in a kiln
E010: Describe drying-related defects in lumber and their causes
DUTY F:
Veneer and Wood Composites
Task:
F001: Describe different methods and applications in producing veneers
F002: Describe the correct storage and handling of veneers
F003: Define the field of wood composites
F004: List advantages and disadvantages of wood composites
F005: Identify the commercial value of different wood composite materials
WORK PLANNING <i>(For Every Project)</i>
DUTY G:
Design
Task:
G001: Describe good principles in design
G002: Discuss methods of constructing furniture

G003: Explain design and function of a project
G004: Discuss aesthetic proportions and features of wood components and furniture
G005: Discuss the impact that grain patterns, stains, colors, etc., have on a selected project
G006: Discuss appropriate surfaces (visible and nonvisible) for the selected project
G007: Select an appropriate connection method
G008: Discuss the characteristics of functional and nonfunctional design
DUTY H:
Information Gathering
Task:
H001: Select project components and raw materials from books, catalogues, Internet, etc.
H002: Discuss assembly drawings and assembly directions for project components
H003: Discuss norms and regulations (i.e., OSHA, ISO, etc.) that pertain to the project
DUTY I
Work Flow
Task:
I001: Sequence work steps for the project
I002: Evaluate the effectiveness of machinery and tools required for the project
I003: Discuss appropriate preventive measures for job safety and health protection
I004: Determine labor hours for the project (including time for helpers)
I005: Develop a format for customer invoicing

DUTY J: Project Presentation
Task:
J001: Review bill of materials and labor estimates
J002: Determine the total overhead cost for the project
J003: Discuss advantages of design features and workmanship incorporated in the project
J004: Prepare a customer presentation
INDUSTRY-SPECIFIC MATHEMATICS
DUTY K: Measurement
Task:
K001: Measure length using a rule or tape measure
K002: Measure objects using a slide caliper and micrometer
K003: Measure objects using metric and customary measuring systems
K004: Perform basic mathematical computations used in measurement
K005: Explain the term “board foot”
K006: Determine the board footage of actual boards
K007: Calculate the board footage of volumetric objects, such as a bunk of lumber, capacity of a dry kiln, etc.
K008: Describe other measuring systems common in the national and international trade of forest and wood products, such as chord, bole, etc.

DUTY L: Area and Volumetric Calculations
Task:
L001: Calculate material requirements for square and triangular areas
L002: Apply formula for calculating area and circumference of a circle in an industry-specific application
L003: Calculate the ft ³ of a wooden block
L004: Calculate the volume of wood in a log
DUTY M: Angles
Task:
M001: Review basic geometric concepts
M002: Draw different angles, and determine their degrees
M003: Measure different angles on woodworking machinery
M004: Add and subtract angles
M005: Discuss application of compound angles
DUTY N: Percentages
Task:
N001: Calculate percentages using industry examples
N002: Calculate reject rates of machine runs
N003: Calculate total material requirements

DUTY O: Wood Moisture Calculations
Task:
O001: Determine moisture content in wood
O002: Observe and measure dimensional changes in wood
O003: Calculate incremental, dimensional changes in wood
DUTY P: Project Cost
Task:
P001: Discuss prices for different raw materials
P002: Calculate total material cost of a project
DUTY Q: Feed Speed
Task:
Q001: Measure feed rates of various woodworking machines
Q002: Calculate expected machine output
Q003: Observe and discuss surface qualities at different machine speeds
DUTY R: Planning a Project with a Working Drawing
Task:
R001: Sketch an example of each type of drawing technique
R002: Discuss “exploded view”
R003: Produce a working drawing
R004: Draw the selected class project in the appropriate drawing style

R005: Sketch and dimension a floor plan
DUTY S: Bill of Materials
Task:
S001 Determine a bill of materials for project construction
S002: Develop a format for customer invoicing that shows bill of materials and costs
SHOP PREPARATIONS
DUTY T: Safety
Task:
T001: Explain the term “OSHA,” and state some regulations covered by OSHA
T002: Recite the emergency plan for the shop
T003: Discuss hearing loss
T004: Describe personal protective equipment (PPE) used in a woodworking facility
T005: Explain the term “MSDS” and the information it contains
T006: Discuss machine guards and the importance of having them in place at all times
T007: Name the basic safety rules for electrical equipment
T008: Practice a “lock-out – tag-out procedure” on one stationary woodworking machine in your facility
DUTY U: Hand Tools
Task:
U001: Review hand tools used in the woodworking trade
U002: Discuss basic safety rules for using hand tools

U003: Discuss typical applications of hand tools
U004: State proper techniques for using hand tools
DUTY V: Tool Sharpening
Task:
V001: Describe safety precautions followed while sharpening hand tools
V002: List different tool materials, their properties, and preferred applications
V003: Explain operation of the grinder
V004: Practice sharpening tools using a grinder
V005: Discuss advantages of automatic grinding equipment
V006: Practice sharpening and honing
DUTY W: Use of Power Tools
Task:
W001: Explain general safety procedures for the use of power tools
W002: Explain specific safety procedures for portable power tools
W003: Practice operation of portable power tools, applying appropriate safety procedures
W004: Explain specific safety procedures for stationary power tools
W005: Practice operation of stationary power tools, applying appropriate safety procedures

DUTY X: Operation of Power Tools (<i>apply to each machine installed in the shop</i>)
Task:
X001: Explain the function of each machine
X002: Perform tool change and bring each machine back into operational status
X003: Perform preventive maintenance procedures on each machine
DUTY Y: Preparing Stock for Layout
Task:
Y001: Select the appropriate stock for a job
Y002: Glue stock to rough size using proper clamping procedures
Y003: Square rough stock to actual size for the job
DUTY Z: Wood Sanding
Task:
Z001: Explain the purpose of sanding
Z002: Define terms used in sanding wood
Z003: Describe different abrasives and their common applications
Z004: Sand wood parts using a hand held abrasive
Z005: Sand wood parts with a power sander
Z006: Change abrasive on a power sander

DUTY AA: Fasteners
Task:
AA001: Identify types and purposes of fasteners related to woodworking
AA002: Explore style, functionality, and cost of fasteners from catalogues and the Internet
AA003: Use at least three different kinds of fasteners in woodworking projects
DUTY BB: Adhesives
Task:
BB001: Identify appropriate adhesives for assembling various projects
BB002: Apply adhesives
DUTY CC: Cutting Joints with Power Equipment and Hand Tools
Task:
CC001: Explain the technique for constructing basic joints
CC002: Lay out wood joints on stock
CC003: Construct examples of basic joints
DUTY DD: Assembly Techniques
Task:
DD001: Explain procedures for assembling a job
DD002: Complete a trial assembly
DD003: Assemble a job using prepared stock and appropriate adhesives, clamps, and fastening devices

DUTY EE: Finishing
Task:
EE001: Discuss terms related to finishing wooden furniture
EE002: State safety procedures related to finishing wooden furniture
EE003: Describe the safe storage of finishes
EE004: Identify types of finishes and their purpose
EE005: Select an appropriate finish for a job
EE006: Apply finishes using manual devices such as a sponge, paint brush, or roller
EE007: Explain the proper care, cleaning, and maintenance of manual devices used in applying finishes
EE008: Apply finishes with a spray gun
EE009: Clean equipment, store supplies, and dispose of excess materials properly
DUTY FF: Wood Veneers and Laminates
Task:
FF001: Define terms involved with laminates and veneers
FF002: Apply laminates and veneers to wood parts
DUTY GG: Assembling an Advanced Project
Task:
GG001: True up stock for project construction
GG002: Clamp all stock to rough size

GG003: Square rough stock to correct size
GG004: Sand stock using power sander
GG005: Cut all joints laid out on stock
GG006: Assemble project using prepared stock and appropriate fastening devices
GG007: Perform finish sanding and scraping
GG008: Apply finish to advanced project
DUTY HH: Careers in Wood Manufacturing Industry
Task:
HH001: Discuss careers within the wood manufacturing industry
HH002: List local business and industries involved in wooden furniture making
HH003: Visit a local business or industry involved in the wood manufacturing industry

Task Definitions

State experts in the occupational field of wood manufacturing 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.

INDUSTRY SPECIFIC THEORY
DUTY A:
Trees
Task:
<p>A001: Discuss a structural diagram of a tree</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • list the major parts of a tree <p>Process/Skill Questions</p>
<p>A002: Explain the functions of the different parts of a tree</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • list the main functions of each major structure <p>Process/Skill Questions</p>
<p>A003: Name and identify conifers and broad leaf species</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • list similarities between hardwoods and softwoods • list differences between hardwoods and softwoods <p>Process/Skill Questions</p>
<p>A004: Explain the processes and functions of a tree on the microscopic level, such as photosynthesis, movement of water, etc.</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • state the elements of photosynthesis • identify the cambium layer • identify wood rays • identify annual rings <p>Process/Skill Questions</p>

DUTY B: Forestry
Task:
B001: Identify major forest regions in the United States
<p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> state facts as they relate to forest regions in the Northeast, Midwest, Southern, and Northwest United States <p>Process/Skill Questions</p>
B002: Discuss local forest regions and their impact on local economies
<p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> list the major forest regions in the state of Arkansas review the impact the industry has on each region <p>Process/Skill Questions</p>
B003: Practice forest measurements on a short timber cruise
<p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> discuss the method for determining percentages of hardwood and softwood within a stand use standard stand tally procedures discuss pine and hardwood maturity as it relates to logging for lumber explain the term “silviculture” and related terms, such as “life cycles of trees” and “pruning” <p>Process/Skill Questions</p>
B004: Discuss forest protection (fires, insects, and diseases)
<p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> identify natural diversity identify plantation monocultures identify liabilities of native diversity in monocultures <p>Process/Skill Questions</p>
DUTY C: Environmental Issues
Task:
C001: Discuss the issue of protecting forests (local forests, rain forests, etc.)
<p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> review the impact conservation has on local flora and fauna

- review the impact conservation has on air, water, and soil qualities

Process/Skill Questions

C002: Explain the term “sustainable forestry” and view video by Patrick Moore

Definition: Process should include the following:

- discuss rotation cycles
- identify rare and endangered species

Process/Skill Questions

C003: Explain the terms “selective cutting” and “clear cutting” and their applications

Definition: Process should include the following:

- review selective cutting as it relates to private versus industrial logging
- discuss clear cutting within industrial logging

Process/Skill Questions

C004: Discuss current environmental issues, such as the Kyoto Protocol, global warming, depletion of the ozone layer, etc.

Definition: Process should include the following:

- discuss how environmental issues are connected
- discuss the impact trees have on the environment

Process/Skill Questions

**DUTY D:
Lumber and Lumber Grading**

Task:

D001: Collect and identify samples of various wood species

Definition: Process should include the following:

- identify species by leave, bark, and shape

Process/Skill Questions

D002: List the working characteristics of various wood species

Definition: Process should include the following:

- state the impact of visual appeal
- list applications of various wood species

Process/Skill Questions

<p>D003: List natural defects in wood</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • identify splits, warps, knots, and mold <p>Process/Skill Questions</p>
<p>D004: Name grades of softwood lumber</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • state the basic procedures for grading <p>Process/Skill Questions</p>
<p>D005: Name grades of hardwood lumber</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • state the basic procedures for grading <p>Process/Skill Questions</p>
<p>D006: List different sawing patterns for lumber and their preferred use</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • state quantity of waste for each sawing pattern (milling techniques) <p>Process/Skill Questions</p>
<p>D007: Identify the commercial value of various wood species in different lumber grades</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • state the impact availability has on commercial value <p>Process/Skill Questions</p>
<p>DUTY E: Wood Moisture Relationship and Lumber Drying</p>
<p>Task:</p>
<p>E001: Explain the term “relative humidity” as it relates to lumber</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • define relative humidity <p>Process/Skill Questions</p>
<p>E002: Explain the transport of water in lumber</p> <p><i>Definition:</i> Process should include the following:</p>

- list wood structure(s) involved in water transport

Process/Skill Questions

E003: Describe the process of shrinkage and swelling in wood

Definition: Process should include the following:

- state visual cues that indicate shrinkage and swelling in wood

Process/Skill Questions

E004: Describe problems caused by wood moisture in manufacturing wood products

Definition: Process should include the following:

- list methods used to minimize problems caused by wood-moisture

Process/Skill Questions

E005: Measure the moisture content of different wood samples using a moisture meter

Definition: Process should include the following:

- describe function of a moisture meter
- discuss EMC
- describe use of a moisture meter

Process/Skill Questions

E006: Measure wood movements under changing climatic conditions

Definition: Process should include the following:

- list types of warps
- discuss size differentials related to grain direction

Process/Skill Questions

E007: Describe ideal conditions for storing lumber

Definition: Process should include the following:

- describe covered storage in ambient air conditions
- describe covered storage in controlled environments

Process/Skill Questions

E008: List methods of drying lumber

Definition: Process should include the following:

- define air dry

- define kiln dry

Process/Skill Questions

E009: Explain the process of drying lumber in a kiln

Definition: Process should include the following:

- describe a kiln
- list the process elements in drying lumber in a kiln

Process/Skill Questions

E010: Describe drying-related defects in lumber and their causes

Definition: Process should include the following:

- identify warps and their causes
- identify splits and their causes

Process/Skill Questions

**DUTY F:
Veneer and Wood Composites**

Task:

F001: Describe different methods and applications in producing veneers

Definition: Process should include the following:

- list methods and applications in producing veneers

Process/Skill Questions

F002: Describe the correct storage and handling of veneers

Definition: Process should include the following:

- list procedures followed in storage and handling veneers

Process/Skill Questions

F003: Define the field of wood composites

Definition: Process should include the following:

- list primary wood composites

Process/Skill Questions

F004: List advantages and disadvantages of wood composites

Definition: Process should include the following:

- list advantages and disadvantages as they relate to stability, workability, weight, off gasing

- name typical applications for wood composites

Process/Skill Questions

F005: Identify the commercial value of different wood composite materials

Definition: Process should include the following:

- state commercial value of particle board versus MDF versus hardboard or Masonite

Process/Skill Questions

WORK PLANNING (For Every Project)

**DUTY G:
Design**

Task:

G001: Describe good principles in design

Definition: Process should include the following:

- list elements of design--i.e., line, shape, color, texture
- list principles of design--i.e., harmony, repetition, balance, proportion
- explain form and function

Process/Skill Questions

G002: Discuss methods of constructing furniture

Definition: Process should include the following:

- select the method of construction for a piece of wooden furniture

Process/Skill Questions

G003: Explain design and function of a project

Definition: Process should include the following:

- discuss furniture styles and periods throughout history
- discuss history of wooden furniture design as it relates to furniture styles and function

Process/Skill Questions

G004: Discuss aesthetic proportions and features of wood components and furniture

Definition: Process should include the following:

- discuss the Golden Rectangle to include curves

Process/Skill Questions

G005: Discuss the impact that grain patterns, stains, colors, etc., have on the selected project

Definition: Process should include the following:

- describe the procedure used to assess the impact of grain patterns, stains, colors, etc.

Process/Skill Questions

G006: Discuss appropriate surfaces (visible and nonvisible) for the selected project

Definition: Process should include the following:

- review solid lumber grades and panel products

Process/Skill Questions

G007: Select an appropriate connection method

Definition: Process should include the following:

- discuss the demands on individual parts of the selected project
- match joinery method to desired level of workmanship

Process/Skill Questions

G008: Discuss characteristics of functional and nonfunctional design

Definition: Process should include the following:

- identify differences between functional and nonfunctional design
- match function to the project need

Process/Skill Questions

**DUTY H:
Information Gathering**

TASK:

H001: Select project components and raw materials from books, catalogues, Internet, etc.

Definition: Process should include the following:

- list available raw materials appropriate for project

Process/Skill Questions

H002: Discuss assembly drawings and assembly directions for project components

Definition: Process should include the following:

- list required hardware
- list required adhesives and fasteners
- identify joinery details

- determine all required dimensions

Process/Skill Questions

H003: Discuss norms and regulations (i.e., OSHA, ISO, etc.) that pertain to the project

Definition: Process should include the following:

- identify pertinent norms and regulations
- discuss disposal of finishes and adhesives

Process/Skill Questions

**DUTY I:
Work Flow**

Task:

I001: Sequence work steps for the project

Definition: Process should include the following:

- define individual work steps

Process/Skill Questions

I002: Evaluate the effectiveness of machinery and tools required for project

Definition: Process should include the following:

- list machinery and tools required for project

Process/Skill Questions

I003: Discuss appropriate preventive measures for job safety and health protection

Definition: Process should include the following:

- list required personal protective equipment (PPE)
- discuss shop safety

Process/Skill Questions

I004: Determine labor hours for project (including time for helpers)

Definition: Process should include the following:

- assign costs to labor
- estimate time requirements for each work step (including set-up times and attrition rates)

Process/Skill Questions

I005: Develop a format for customer invoicing

Definition: Process should include the following:

- show labor hours and associated costs
- discuss change orders
- show material bid
- discuss firm bid
- discuss miscellaneous overhead

Process/Skill Questions

**DUTY J:
Project Presentation**

Task:

J001: Review bill of materials and labor estimates

Definition: Process should include the following:

- list type of contract and/or proposal options

Process/Skill Questions

J002: Determine the total overhead cost for the project

Definition: Process should include the following:

- list direct and indirect costs associated with project

Process/Skill Questions

J003: Discuss advantages of design features and workmanship incorporated in the project

Definition: Process should include the following:

- review possible design options and associated costs

Process/Skill Questions

J004: Prepare a customer presentation

Definition: Process should include the following:

- create a visual image of the project
- describe design features
- produce a bill of materials and total costs for direct raw materials, labor and overhead
- note changes and improvement suggested by the customer
- list customer references
- discuss type of insurances available

Process/Skill Questions

INDUSTRY SPECIFIC MATHEMATICS

DUTY K:

Measurement

Task:

K001: Measure length using a rule or tape measure

Definition: Process should include the following:

- identify graduations

Process/Skill Questions

K002: Measure objects using a slide caliper and micrometer

Definition: Process should include the following:

- identify graduations

Process/Skill Questions

K003: Measure objects using metric and customary measuring systems

Definition: Process should include the following:

- identify graduations

Process/Skill Questions

K004: Perform basic mathematical computations used in measurement

Definition: Process should include the following:

- convert fractions to decimals
- calculate fractional equations

Process/Skill Questions

K005: Explain the term “board foot”

Definition: Process should include the following:

- define dimensions of board feet
- describe volumetric sales

Process/Skill Questions

K006: Determine the board footage of actual boards

Definition: Process should include the following:

- use pencil and paper, tables, or computer programs

Process/Skill Questions

K007: Calculate the board footage of volumetric objects, such as a bunk of lumber, capacity of a dry kiln, etc.

Definition: Process should include the following:

- use pencil and paper, tables, or computer programs

Process/Skill Questions

K008: Describe other measuring systems common in the national and international trade of forest and wood products, such as chord, bole, etc.

Definition: Process should include the following:

- discuss various measuring systems and their advantages/disadvantages

Process/Skill Questions

**DUTY L:
Area and Volumetric Calculations**

Task:

L001: Calculate material requirements for square and triangular areas

Definition: Process should include the following:

- state formulas

Process/Skill Questions

L002: Apply formula for calculating area and circumference of a circle in an Industry-specific application

Definition: Process should include the following:

- state formulas

Process/Skill Questions

L003: Calculate the ft³ of a wooden block

Definition: Process should include the following:

- state formulas
- convert ft³ measurements into board footages

Process/Skill Questions

L004: Calculate the volume of wood in a log

Definition: Process should include the following:

- discuss the effect various milling methods have on usable lumber

Process/Skill Questions

DUTY M: Angles
Task:
M001: Review basic geometric concepts
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • recite basic theorems Process/Skill Questions
M002: Draw different angles, and determine their degrees
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • discuss basic angles common to the wood manufacturing industry Process/Skill Questions
M003: Measure different angles on woodworking machinery
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • discuss the methods used to ensure equipment setup Process/Skill Questions
M004: Add and subtract angles
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • perform bisection of angles Process/Skill Questions
M005: Discuss the application of compound angles
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • define compound angle Process/Skill Questions
DUTY N: Percentages
Task:
N001: Calculate percentages using industry examples
<i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • explain how to determine percentage Process/Skill Questions

<p>N002: Calculate reject rates of machine runs</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • discuss mathematical process used to determine reject rate <p>Process/Skill Questions</p>
<p>N003: Calculate total material requirements</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • calculate attrition rates • discuss typical attrition rates for wood projects <p>Process/Skill Questions</p>
<p>DUTY O: Wood Moisture Calculations</p>
<p>Task:</p>
<p>O001: Determine moisture content in wood</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • use oven-dry method • use industry tables and graphs • use moisture meter <p>Process/Skill Questions</p>
<p>O002: Observe and measure dimensional changes in wood</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • calculate maximum dimensional change in a wood sample • use industry tables and graphs <p>Process/Skill Questions</p>
<p>O003: Calculate incremental, dimensional changes in wood</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • use industrial examples such as a wooden floor, an edge-glued tabletop, etc. <p>Process/Skill Questions</p>
<p>DUTY P: Project Cost</p>
<p>Task:</p>
<p>P001: Discuss prices of different raw materials</p> <p><i>Definition:</i> Process should include the following:</p>

- use industry publications
- list various resources used to determine raw material cost

Process/Skill Questions

P002: Calculate the total material cost for a project

Definition: Process should include the following:

- use different cost/ft² for raw materials (incl. waste rates)
- use cost/bft for different grades of lumber (incl. waste rates)
- list adhesives, fasteners, abrasives, hardware, and finishes

Process/Skill Questions

**DUTY Q:
Feed Speed**

Task:

Q001: Measure feed rates of various woodworking machines

Definition: Process should include the following:

- use time and linear feet of production

Process/Skill Questions

Q002: Calculate expected machine output

Definition: Process should include the following:

- use different feed settings on machine

Process/Skill Questions

Q003: Observe and discuss surface qualities at different machine speeds

Definition: Process should include the following:

- list species and lumber grade

Process/Skill Questions

**DUTY R:
Planning a Project with a Working Drawing**

Task:

R001: Sketch an example of each type of drawing technique

Definition: Process should include the following:

- describe thumbnail
- describe orthographic
- describe isometric
- describe exploded

- describe how and when each type is used

Process/Skill Questions

R002: Discuss “exploded view”

Definition: Process should include the following:

- list elements included in view

Process/Skill Questions

R003: Produce a working drawing

Definition: Process should include the following:

- list elements included in working drawings
- discuss the type of lines used

Process/Skill Questions

R004: Draw the selected class project in the appropriate drawing style

Definition: Process should include the following:

- include exploded views necessary for construction of the project

Process/Skill Questions

R005: Sketch and dimension a floor plan

Definition: Process should include the following:

- select the drawing style that best illustrates the class project

Process/Skill Questions

**DUTY S:
Bill of Materials**

Task:

S001: Determine a bill of materials for the project construction

Definition: Process should include the following:

- list information normally found on a bill of materials
- explain math concepts applied to a bill of materials
- determine accessories needed for project construction
- calculate the total amounts and cost of all other raw materials and accessories needed for the project

Process/Skill Questions

S002: Develop a format for customer invoicing that shows the bill of materials and costs

Definition: Process should include the following:

- calculate the board footage (incl. waste) for lumber needed in project

Process/Skill Questions

SHOP PREPARATIONS

DUTY T:

Safety

Task:

T001: Explain the term “OSHA,” and state some regulations covered by OSHA

Definition: Process should include the following:

- list regulations that pertain to the wood manufacturing industry

Process/Skill Questions

T002: Recite the emergency plan for the shop

Definition: Process should include the following:

- list elements of each emergency plan

Process/Skill Questions

T003: Discuss hearing loss

Definition: Process should include the following:

- list different hearing protection devices
- explain the concept of decibels and the effect on hearing

Process/Skill Questions

T004: Describe personal protective equipment (PPE) used in a woodworking facility

Definition: Process should include the following:

- review the function, purpose, and maintenance of PPE

Process/Skill Questions

T005: Explain the term “MSDS” and the information it contains

Definition: Process should include the following:

- identify hazardous materials in your facility

Process/Skill Questions

T006: Discuss machine guards and the importance of having them in place at all times

Definition: Process should include the following:

- identify different machine guards in your facility

Process/Skill Questions

T007: Name the basic safety rules for electrical equipment

Definition: Process should include the following:

- list potential hazards related to the use of electrical equipment

Process/Skill Questions

T008: Practice a “lock-out – tag-out procedure” on one stationary woodworking machine in your facility

Definition: Process should include the following:

- list procedures followed during lock-out/tag-out

Process/Skill Questions

**DUTY U:
Hand Tools**

Task:

U001: Review hand tools used in the woodworking trade

Definition: Process should include the following:

- list their primary uses
- review inappropriate uses of tools

Process/Skill Questions

U002: Discuss basic safety rules for using hand tools

Definition: Process should include the following:

- list basic safety rules for hand-tool use.
- state proper conditions of different hand tools

Process/Skill Questions

U003: Discuss typical applications of hand tools

Definition: Process should include the following:

- list typical applications of hand tools

Process/Skill Questions

U004: State proper techniques for using hand tools

Definition: Process should include the following:

- review proper body position
- review application of force with tools

- review direction of use

Process/Skill Questions

DUTY V:

Tool Sharpening

Task:

V001: Describe safety precautions followed while sharpening hand tools

Definition: Process should include the following:

- review eye protection
- discuss spark control

Process/Skill Questions

V002: List different tool materials, their properties, and preferred applications

Definition: Process should include the following:

- define angles in tool geometry

Process/Skill Questions

V003: Explain operation of the grinder

Definition: Process should include the following:

- select grinding material and grinding technique for each hand tool
- name parts of the grinding machine

Process/Skill Questions

V004: Practice sharpening tools using a grinder

Definition: Process should include the following:

- describe how to sharpen a tool using a grinder

Process/Skill Questions

V005: Discuss advantages of automatic grinding equipment

Definition: Process should include the following:

- list differences between automatic and non-automatic grinding equipment

Process/Skill Questions

V006: Practice sharpening and honing

Definition: Process should include the following:

- review abrasive grit progression
- discuss honing techniques
- discuss honing principles to include appropriate angle and lapping

- review jigs used with chisels and plane iron honing

Process/Skill Questions

DUTY W:

Use of Power Tools

Task:

W001: Explain general safety procedures for the use of power tools

Definition: Process should include the following:

- discuss the importance of a power tool safety checklist

Process/Skill Questions

W002: Explain specific safety procedures for portable power tools

Definition: Process should include the following:

- review sequence of procedures

Process/Skill Questions

W003: Practice the operation of portable power tools, applying appropriate safety procedures

Definition: Process should include the following:

- state the operational procedures for portable power tools
- state the procedures for setup and adjustment of portable power tools, applying appropriate safety procedures

Process/Skill Questions

W004: Explain specific safety procedures for stationary power tools

Definition: Process should include the following:

- review sequence of procedures

Process/Skill Questions

W005: Practice the operation of stationary power tools, applying appropriate safety procedures

Definition: Process should include the following:

- state the procedures for setup and adjustment of stationary power tools, applying the appropriate safety procedures
- explain the operational procedures for stationary power tools

Process/Skill Questions

<p>DUTY X: Operation of Power Tools (<i>apply to each machine installed in the shop</i>)</p>
<p>Task:</p>
<p>X001: Explain the function of each machine</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • identify the machine and its parts • describe other uses and applications of the machine <p>Process/Skill Questions</p>
<p>X002: Perform tool change, and bring each machine back into operational status</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • set up each machine for different applications and operate, applying appropriate safety procedures <p>Process/Skill Questions</p>
<p>X003: Perform preventive maintenance procedures on each machine</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • list reoccurring maintenance procedures • review importance of preventive maintenance <p>Process/Skill Questions</p>
<p>DUTY Y: Preparing Stock for Layout</p>
<p>Task:</p>
<p>Y001: Select the appropriate stock for the job</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • describe characteristics of stock • discuss stock defects and hidden dangers • discuss size and grading considerations • list six sides of a board <p>Process/Skill Questions</p>
<p>Y002: Glue stock to rough size using proper clamping procedures</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • explain steps for gluing stock for a job

- identify type of glue clamps, their purpose, and appropriate placement

Process/Skill Questions

Y003: Square rough stock to actual size for the job

Definition: Process should include the following:

- explain steps for squaring glued stock
- discuss methods for “truing up” stock for a job
- list truing sequence for stock

Process/Skill Questions

**DUTY Z:
Wood Sanding**

Task:

Z001: Explain the purpose of sanding

Definition: Process should include the following:

- discuss the impact sanding has on function, style, aesthetics, etc.

Process/Skill Questions

Z002: Define terms used in sanding wood

Definition: Process should include the following:

- review grain
- review abrasive loading
- review abrasive grit

Process/Skill Questions

Z003: Describe different abrasives and their common applications

Definition: Process should include the following:

- list types of abrasives, both natural and synthetic--i.e., silicon carbide, aluminum, carborundum, diamond
- list backings used with abrasives

Process/Skill Questions

Z004: Sand wood parts using a hand-held abrasive

Definition: Process should include the following:

- explain procedures for hand sanding wooden parts
- discuss grain direction and grit

Process/Skill Questions

Z005: Sand wood parts with a power sander

Definition: Process should include the following:

- name different types of power sanders
- explain procedures for power sanding wood parts
- explain safe operation of power sanders

Process/Skill Questions

Z006: Change the abrasive on a power sander

Definition: Process should include the following:

- explain the procedure for changing abrasives

Process/Skill Questions

**DUTY AA:
Fasteners**

Task:

AA001: Identify types and purposes of fasteners related to woodworking

Definition: Process should include the following:

- define term “fasteners” as it relates to wood manufacturing
- list type of fasteners used in woodworking

Process/Skill Questions

AA002: Explore style, functionality, and costs of fasteners from catalogues and the Internet

Definition: Process should include the following:

- discuss the impact fastener selection has on style and functionality
- discuss the process for selection of various types of fasteners

Process/Skill Questions

AA003: Use at least three different kinds of fasteners in woodworking projects

Definition: Process should include the following:

- explain the correct techniques for using different fasteners

Process/Skill Questions

**DUTY BB:
Adhesives**

Task:

BB001: Identify appropriate adhesives for assembling various projects

Definition: Process should include the following:

- list the major types of adhesives
- identify characteristics of adhesives

Process/Skill Questions

BB002: Apply adhesives

Definition: Process should include the following:

- describe appropriate methods of applying adhesives
- discuss clamping and fastening techniques

Process/Skill Questions

**DUTY CC:
Cutting Joints with Power Equipment and Hand Tools**

Task:

CC001: Explain the technique for constructing basic wood joints

Definition: Process should include the following:

- match joints to different applications
- identify eight basic wood joints

Process/Skill Questions

CC002: Lay out wood joints on stock

Definition: Process should include the following:

- explain the procedure for laying out of wood joints
- list the appropriate tools for layout
- evaluate accuracy of joint layout

Process/Skill Questions

CC003: Construct examples of basic wood joints

Definition: Process should include the following:

- describe the technique used to construct basic joints

Process/Skill Questions

**DUTY DD:
Assembly Techniques**

Task:

DD001: Explain the procedures for assembling a job

Definition: Process should include the following:

- select the optimum joint or fastener method

Process/Skill Questions

DD002: Complete a trial assembly

Definition: Process should include the following:

- explain the purpose of trial assembly
- determine necessary adjustments

Process/Skill Questions

DD003: Assemble a job using prepared stock and appropriate adhesives, clamps, and fastening devices

Definition: Process should include the following:

- describe the process of job assembly using prepared stock and appropriate adhesives, clamps, and fastening devices

Process/Skill Questions

**DUTY EE:
Finishing**

Task:

EE001: Discuss terms related to finishing wooden furniture

Definition: Process should include the following:

- define surface preparation
- define defect correction
- define color change
- define surface beautification and protection

Process/Skill Questions

EE002: State safety procedures related to finishing wooden furniture

Definition: Process should include the following:

- review ventilation procedures
- define volatility
- review OSHA as it relates to air quality, storage, disposal, PPE, and MSDS guidance

Process/Skill Questions

EE003: Describe the safe storage of finishes

Definition: Process should include the following:

- list the requirements for the storage of various finishes

Process/Skill Questions

EE004: Identify types of finishes and their purpose

Definition: Process should include the following:

- list characteristics of each type of finish to include oil-, water-, and alcohol-based products
- explain how finishes for wood are produced

Process/Skill Questions

EE005: Select an appropriate finish for a job

Definition: Process should include the following:

- explain the criteria for selecting an appropriate finish (oil-, water-, and solvent based)

Process/Skill Questions

EE006: Apply finishes using manual devices such as a sponge, paint brush, or roller

Definition: Process should include the following:

- discuss appropriate techniques for applying finish
- describe safe application techniques for oil-, water-, and solvent-based finishes

Process/Skill Questions

EE007: Explain proper care, cleaning, and maintenance of manual devices used in applying finishes

Definition: Process should include the following:

- state procedures for cleaning and maintaining manual devices
- list agents used to clean manual devices
- discuss the disposal procedures for cleaning agents

Process/Skill Questions

EE008: Apply finishes with a spray gun

Definition: Process should include the following:

- explain the operation of a spray gun used in the application of finishes
- describe safe procedures for applying finishes with a spray gun (HULP safety issues)

Process/Skill Questions

EE009: Clean equipment, store supplies, and dispose of excess materials properly

Definition: Process should include the following:

- explain proper care, cleaning, and maintenance of spray guns

- explain proper disposal of excess finishes

Process/Skill Questions

**DUTY FF:
Wood Veneers and Laminates**

Task:

FF001: Define terms involved with laminates and veneers

Definition: Process should include the following:

- list terms involved with laminates and veneers

Process/Skill Questions

FF002: Apply laminates and veneers to wood parts

Definition: Process should include the following:

- explain safety procedures involved with plastic laminates
- explain procedures for applying plastic laminates
- explain procedures for sizing and finishing laminates and veneers

Process/Skill Questions

**DUTY GG:
Assembling an Advanced Project**

Task:

GG001: True up stock for project construction

Definition: Process should include the following:

- list steps for truing up stock for project construction

Process/Skill Questions

GG002: Clamp all stock to rough size

Definition: Process should include the following:

- state steps for gluing and clamping stock to rough size

Process/Skill Questions

GG003: Square rough stock to correct size

Definition: Process should include the following:

- list steps for squaring rough-glued stock to correct size

Process/Skill Questions

GG004: Sand stock using power sander

Definition: Process should include the following:

- explain techniques for sanding stock with power sander

Process/Skill Questions

GG005: Cut all joints laid out on stock

Definition: Process should include the following:

- cite safe techniques for cutting joints laid out on stock
- list the procedure for layout of joints on stock
- draw layout for joints on stock

Process/Skill Questions

GG006: Assemble project using prepared stock and appropriate fastening devices

Definition: Process should include the following:

- state steps in assembling projects using prepared stock and appropriate fastening devices
- complete a trial assembly to determine necessary adjustments

Process/Skill Questions

GG007: Perform finish sanding and scraping

Definition: Process should include the following

- describe proper finish sanding and scraping procedures
- discuss purpose for scraping

Process/Skill Questions

GG008: Apply finish to advanced project

Definition: Process should include the following:

- discuss selection of type finish
- discuss application method used
- review safe handling procedures for various type of finishes

Process/Skill Questions

**DUTY HH:
Careers in Wood Manufacturing Industry**

Tasks:

HH001: Discuss careers within wood manufacturing industries

Definition: Process should include the following

- list 10 careers within the industry

Process/Skill Questions

HH002: List local business and industries involved in wooden furniture making

Definition: Process should include the following:

- list local businesses with apprentice programs

Process/Skill Questions

HH003: Visit a local business or industry involved in wood manufacturing

Definition: Process should include the following:

- discuss the future of wood manufacturing jobs in your community

Process/Skill Questions

SkillsUSA/HOSA

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

Process/Skill Questions

A007: Recognize the 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 a personal plan to overcome barriers to listening

Process/Skill Questions

A009: Participate in a shadowing activity

Definition: Process should include the following:

- Summarize the experience of the job shadowing activity

Process/Skill Questions

A010: Identify the components of an employment portfolio

Definition: Process should include the following:

- Identify the 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 the 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 an 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 the 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 an 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 the responsibilities of managers and supervisors

Process/Skill Questions

B016: Recognize safety issues

Definition: Process should include the following:

- Discuss the 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

Curriculum Frameworks

Purpose

This section of the framework contains material to help instructors in technical and professional programs reinforce basic skills in the areas of Reading and Writing, Mathematics, 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 always have 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, and 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 Career and Technical Education 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 Career and Technical Education 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 career and technical 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 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 allow the instructor to set the tone for the material. This method 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 people to find out the top five 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.)
- 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 and has collected data from this work with Arkansas employers. 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 U.S. military, and 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.
- The U.S. Department of Labor (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 Web site at www.dol.gov.
- The 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.
- The 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 Career and Technical Education 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 two examples of workplace materials* on students' reading level.</p> <p>With the first, allow students to read information and then answer brief recall questions. 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</p>

	visually? Discuss learning styles and impact on the job.
<i>Follow, give oral instructions</i>	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.
<i>Follow, give written instructions</i>	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, identify technical vocabulary</i>	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.
Identify, 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: symbols, abbreviations, acronyms. Classify each one and write in the meaning.
Understand, use rules of grammar, usage, spelling, punctuation	Identify the missing punctuation marks, misspelled words, and incorrect use of

	<p>grammar from workplace materials*.</p> <p>Correct the mistakes.</p>
<i>Discuss</i> uses and purposes of a variety of workplace communication tools	Find examples of a business letter, memo, report, brochure, proposal, schematic, map, and diagram.
<i>Duplicate</i> process demo by instructor	Using a workplace process, demonstrate steps to complete and have students perform individually or in groups.
<i>Notice, apply</i> word analysis techniques	Using workplace materials*, identify prefixes, suffixes, or roots that indicate meaning (e.g., therma = heat). ¹
<i>Match</i> 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.
<i>Read</i> for main ideas and details	Use a graphic organizer ¹ to show main ideas and supporting details.
<i>Distinguish</i> 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.
<i>Distinguish</i> between rows and columns	Using charts or tables from workplace materials*, discuss the reasons for this format.
<i>Identify</i> a cell as a block where a row and column intersect	Identify the quantity in a particular cell.
<i>Select, use</i> appropriate resources and reference tools	<p>Explain the uses for the following: dictionary, thesaurus, almanac, atlas, card catalog, encyclopedia.</p> <p>List reasons for choosing one reference tool over another.</p> <p>Use reference tools to answer questions related to industry or current events.</p>
<i>Paraphrase</i> written or oral material into summary form	Using workplace materials*, determine the best way to condense or shorten the

	<p>material so as to give an overview to a layperson.</p> <p>Using a set of guidelines appropriate to students' level in length and detail, summarize the information into bullet points.</p>
<i>Interpret, fill out/complete forms and records</i>	<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 a partner.</p> <p>Create a form or document to be used in a workplace process.</p>
<i>Use, develop a process for remembering details</i>	<p>Use pneumatic devices to organize and remember details. Pneumatic devices¹ include Semantic Maps, Thought Webs, and other creative tools to organize thinking.</p>
<i>Proofread, correct mistakes in written drafts</i>	<p>Using a newspaper article, locate and mark mistakes in grammar, punctuation, or usage.</p> <p>Correct mistakes in written drafts.</p>
<i>Examine different types of writing used in the workplace (reports, memos, brochures, logs, blueprints, formulas, etc.)</i>	<p>Gather samples of workplace materials*. Identify each by type.</p> <p>Compare and contrast the difference between:</p> <ul style="list-style-type: none"> • audience (who the document is written for), • length, • background information/education needed to understand material, • level of detail, • organization and layout of the document.
<i>Understand the writing process</i>	<p>In order to apply the writing process, create a workplace communication tool to be used</p>

	<p>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>
<p><i>Identify, create</i> sentences of different types</p>	<p>Using workplace materials*, find sentences of varying types. Examples include simple sentences (subject + predicate) and complex sentences (subject + predicate including clauses).</p> <p>Write sentences, paragraphs, or essays using sentences of different types (e.g., write a two-paragraph summary of today’s lesson).</p>
<p><i>Identify, use</i> 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, use correctly</i> 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/her 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 five words per week. Award bonus points.</p>
<p><i>Identify, use correctly</i> 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/her 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 sources.</p>
<p><i>Identify, use</i> 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). Examples--</p> <p>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 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>Have students write the instructions for disassembly.</p>
Cross-reference materials to compare information	Using more than one source document, compare the information given.
Interpret reasoning behind rules or regulations	Using workplace materials*, make a list of possible reasons or justifications for a safety guideline, regulation, etc.
Show contrasts between approaches	<p>Given a workplace scenario, write a brief approach to solving the problem. (Working in groups would be beneficial.)</p> <p>Compare and contrast each approach from the perspective of a worker, manager, supervisor.</p>

<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 two or more partners related to industry, show or explain how they are interrelated (e.g., explain the relationship between social workers and hospitals).
Given examples of emergency situations, identify a real-world course of action	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).
<i>Identify preventive measures for maintenance of a system</i>	List the needed routine maintenance to keep a system working properly.
<i>Predict new standards or rules that may become necessary in the future</i>	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).
<i>Improve a process by streamlining (locating waste) or decreasing lost time</i>	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.
<i>Prepare a model explaining a concept</i>	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 Career and Technical Education 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> <i>Master the list of skills employers want for the workplace regarding mathematics</i></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, apply problem-solving process</i></p>	<p>Define the problem</p> <ul style="list-style-type: none"> • What is being asked? <p>Decide on a type of solution.</p> <ul style="list-style-type: none"> • Multistep or single-step question?

	<p>Try any of these:</p> <ul style="list-style-type: none"> • Estimate an answer • Draw a diagram • Find a pattern • 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>Locate information you need.</p> <ul style="list-style-type: none"> • Do you have all the components? <p>Get missing information.</p> <ul style="list-style-type: none"> • You may need to perform some other calculations <p>Calculate.</p> <ul style="list-style-type: none"> • Look at the answer. How should the remainder be expressed? <p>Check the solution.</p> <ul style="list-style-type: none"> • Is it reasonable?
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.</p> <p>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> <p>Take a series of sample measurements, and round them to the nearest decimal place identified by the instructor.</p>
<i>Estimate numbers</i>	<p>The skill of making close estimations is tied to understanding accuracy. Discuss real-life situations in which 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 in which 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.</p> <p>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 bench-

	mark measurement?
Calculate with whole numbers; perform one-step problems with basic operations	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of addition, subtraction, multiplication, and division.
Perform problems that require an understanding of the order of operations	<p>Using workplace materials*, make a list of 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>
Understand the relationship between decimals, fractions, and percentages	Make a table comparing fractions, decimals, and percentages.
Compute with fractions, decimals, and percentages, and show an understanding of the relationship between them	<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: <ul style="list-style-type: none"> 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. $\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20}$ ▪ Convert the fractions to a whole number. (Total answer equals one class' worth of answers.) $\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20} = 1$ ▪ Convert the fractions to percentages. $\frac{10}{20}$ means 10 divided by 20 = 0.50 0.50 = 50% <p>Move the decimal two places to the right. 0.50 = 50%</p> <p>$\frac{2}{20}$ means 2 divided by 20 = 0.10 0.10 = 10%</p> <p>$\frac{8}{20}$ means 8 divided by 20 = 0.40 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 percentages.</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

<i>Obtain squares and square roots</i>	<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 two common answers to 32 (answer = 9, not 6). How would an incorrect value affect the work on the job?</p>
<i>Convert units of measure: Recognize components of measuring systems (U.S. and metric) for length</i>	Discuss industry measures and terms relating to length.
<i>Convert units of measure: Recognize components of measuring systems (U.S. and metric) for mass/weight</i>	Discuss industry measures and terms relating to mass/weight.
<i>Convert units of measure: Recognize components of measuring systems (U.S. and metric) for volume</i>	Discuss industry measures and terms relating to volume.
<i>Measure with a certain degree of accuracy</i>	<p>Estimate measurements.</p> <p>Using workplace materials* and tools, take measurements of work-related and classroom items.</p> <p>Depending on ability level, students may measure to the nearest foot, inch, centimeter, etc.</p>
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 formulas</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.
Recognize components of time systems (clocks and calendars)	<ul style="list-style-type: none"> • a.m. and p.m. • Leap year • Military time
Discuss, identify, understand terms relating to measuring time	Discuss the units of time measurement and time vocabulary: second, minute, hour, day, week, month, year, leap year, fiscal year, quarter, annual, biannual, etc.
Understand that time can be expressed in terms of equivalencies	<p>Show the time equivalencies using fractions. For example:</p> $1 \frac{1}{2} \text{ days} = \underline{\hspace{1cm}} \text{ hours}$ $\begin{array}{rcl} 1 \text{ day} & = & 24 \text{ hours} \\ + \frac{1}{2} \text{ day} & = & +12 \text{ hours} \\ \hline 1 \frac{1}{2} \text{ days} & = & 36 \text{ hours} \end{array}$
Compute time conversions	<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
Calculate ratio and proportion	<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 the class has three children, how many children will there be altogether? Write the ratios.)</p>
Apply geometry principles: Use formulas for measuring shapes of two dimensions	Determine the formulas that apply to two dimensions: perimeter, area, surface area. Find the perimeter of the classroom.

	<p>Discuss the 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.</p> <p>Find the area of the classroom.</p> <p>Review that all areas are expressed in terms of square units (square inches, square miles, etc.).</p>
<p><i>Apply geometry principles: Use formulas for measuring shapes of three dimensions</i></p>	<p>Review the formulas that apply to three dimensions of objects: volume.</p> <p>Find the volume of common objects such as soda cans, pizza boxes, etc.</p> <p>Review that volume is expressed in cubic units.</p> <p>Discuss industry-specific needs for these formulas. For example, find the volume of a tank or silo.</p>
<p><i>Define terms relating to money</i></p>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles relating to money.</p> <p>For more advanced students, include terms and principles of economics, finance, or statistics.</p>

<i>Perform one-step problems involving money</i>	<p>Make change.</p> <ul style="list-style-type: none"> Count up (rather than backwards) to make change.
<i>Perform multiple-step problems using money</i>	<p>Calculate gross and net earnings.</p> <p>Calculate</p> <ul style="list-style-type: none"> Interest Sales tax Percent off Sale price Profit percentages <p>Perform banking transactions.</p>
<i>Perform business-related financial activities</i>	<p>At a level of complexity appropriate to your industry and to students' ability levels, solve income/expense problems, prepare budgets, etc.</p>
<i>Use a calculator to perform computations</i>	<p>Identify appropriate activities that can be performed using a calculator (calculators allow students to concentrate on problem-solving strategies).</p> <p>Award prizes for weekly activities or competitions.</p>
<i>Calculate measurements taken from measuring devices</i>	<p>Add, subtract, multiply, and divide measurement numbers by plugging them into formulas.</p>
<i>Perform/prepare an inventory</i>	<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	
<i>Recognize types of visual representations</i>	<ul style="list-style-type: none"> Charts Graphs Tables

<p><i>Interpret charts, graphs, and tables</i></p>	<p>Answer simple questions about charts, graphs and tables.</p> <p>Solve multistep problems involving the correlation of graphs and tables.</p>
<p><i>Collect/record data</i></p>	<p>As appropriate to industry, practice sampling methods. Discuss safety precautions for sampling. Visit OSHA at the Department of Labor Web site 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.</p> <p>(Example, "I am thinking of a number between 1 and 50. The person who guesses the number will receive that many bonus points if s/he can tell me the probability of choosing the number correctly.")</p>
<p><i>Use probability models to predict chance events</i></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. Compare the two probabilities.</p>
<p><i>Calculate and interpret statistics</i></p>	<p>Identify the importance of using statistics correctly.</p> <p>Bring examples of statistics from the news or</p>

	<p>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> <p>Challenge students to bring in examples of charts and graphs containing errors.</p>

ACADEMIC STANDARDS FOR SCIENCE
Strategies for Reinforcement
in the Career and Technical Education 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

Objective**Classroom Applications to Industry**

GENERAL SCIENCE	
<p><i>Present</i> <i>Review and discuss</i> Master the list of skills employers want for the workplace regarding science skills</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 discover the cost to employers to educate adult workers • Researching the topic of adult literacy
<p>Perform computations as required to solve problems</p>	<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>
<p>Apply scientific method of inquiry</p>	<p>Identify the steps of the scientific method.</p> <p>Conduct experiments.</p> <p>Understand the following terminology:</p> <ul style="list-style-type: none"> • Conclusions vs. inferences • Variables • Replications • Samples/sample size
<p>Investigate science history as it applies to industry</p>	<p>In groups, research topics in science pertaining to your industry. Have students assign roles for each</p>

	<p>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/mod3.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>
<i>Use scientific instruments to measure aspects of the environment</i>	Gather data on time, length, mass, pressure, volume, acceleration, or other measurables using instruments from the job.
<i>Demonstrate an understanding of data</i>	<p>List the processes involved in gathering data. 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>
<i>Identify the seven basic S I (Systeme International) units</i>	<ul style="list-style-type: none"> • Length: meter, m • Mass: kilogram, kg • Time: second, s • Electric current: ampere, A • Temperature: Kelvin, K • Amount of substance: mole, mol • Luminous intensity: candela, cd

	For a dictionary of units, see http://www.ex.ac.uk/cimt/dictunit/dictunit.htm
<i>Identify S I (Systeme International) Derived units</i>	Choose units appropriate to your industry (hertz, ohm, volt, watt, etc.). Create a picture dictionary demonstrating the concepts.
<i>Review relevant theories, laws, and models</i>	As relating to your industry, discuss important theories, laws, and models.
<i>Use reference tools to solve problems</i>	Use scientific reference tools (such as the Periodic Table of Elements) to learn more about specific industry concepts.
<i>Practice safe lab procedures</i>	Handle equipment with care. Demonstrate safety and first aid procedures. Identify harmful substances.
PHYSICAL SCIENCE	
<i>Understand the cyclical nature of systems</i>	Show, demonstrate, model, track the cycles of any of the following systems: <ul style="list-style-type: none"> • Growth and decay • Food webs • Weather • Water
<i>Analyze/classify matter according to type</i>	Identify types of matter (solids, liquids, gases). Which types are predominantly used in your area of industry?
<i>Explain the concepts of work and power</i>	Identify machines used in industry. Identify how energy levels change when work or power is increased/decreased. Identify fuel sources used in your industry. Discuss internal and external combustion. Create a model demonstrating the uses of levers and pulleys.

<p><i>Be familiar with concepts of motion</i></p>	<p>Measure acceleration and deceleration. 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. Review laws pertaining to motion.</p>
<p><i>Understand concepts related to force</i></p>	<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>
<p><i>Understand and apply principles relating to the atom</i></p>	<p>Understand that atoms have a positive, negative, or neutral charge. (Classify protons, electrons, and neutrons.) Identify ions.</p>
<p><i>Investigate forms of and changes in energy</i></p>	<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</p>

	<p>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 discuss 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:</p> <ul style="list-style-type: none"> • Hydroelectricity • Motors • Solar power • Steam/nuclear • Transformers • Incandescent (light) <p>Show the implications for your industry.</p> <p>As appropriate to your industry, identify electro-chemical 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.</p> <p>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> <ul style="list-style-type: none"> • Amplification

	<ul style="list-style-type: none"> • Audible range • Frequency • Acoustics • Resonance • Speed
<i>Be familiar with principles of heat</i>	<p>Differentiate between the three 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.</p> <p>Define and state examples of chemical reactions.</p> <p>Be familiar with solutions used in your industry.</p> <p>Compare saturated and unsaturated solutions.</p> <p>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 four elements that make up 99% of living organisms [hydrogen (H), oxygen (O), nitrogen (N), and carbon (C)].</p> <p>Element groups:</p> <ul style="list-style-type: none"> • Alkali metals • Alkaline earth metals • Transition metals • Other metals • Metalloids • Nonmetals • Halogens • Noble gases • Rare earth elements
<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.</p> <p>Briefly explore color blindness. What precautions</p>

	should colorblind people take regarding workplace safety? Define situations in which colorblindness impacts a worker's ability to do his/her 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 examples 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:</p> <ul style="list-style-type: none"> • Bacteria • Fungi • Viruses • Insects • Plants • Vertebrates • Invertebrates <p>Compare some of the cell processes (active and passive transport) with 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

	<ul style="list-style-type: none"> • Traits that are inherited are either dominant or recessive from the parent(s) • Cell division by mitosis vs. 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> <ul style="list-style-type: none"> • Aging • Immune system • Skin and Tissues • Blood and hemoglobin • Disease
<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 women working in industry.</p>
<i>Show a general understanding of the</i> 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>

<p><i>Investigate the food cycle</i></p>	<p>Identify food chains, food webs, food pyramids. Show how changes to the food cycle affect the environment and humans.</p> <p>Name the food groups.</p>
<p><i>Understand nutrition and the body's need for a diet that provides vitamins and minerals</i></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 those who always work outdoors) and the health risks associated with job types (office work, mining work, etc.).</p>
<p><i>Observe health code/sanitation requirements</i></p>	<p>Research the development of health code and sanitation requirements, including OSHA.</p> <p>Compare/contrast workplaces of 1850, 1900, 1950, and 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 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 addition to physical health.</p>
<p><i>Investigate/apply</i> principles of anatomy and physiology</p>	<p>As relating to your industry, explore issues relating to anatomy and physiology.</p> <p>Study the skeletal system--the bones of the arm, hand, and neck. Research carpal-tunnel syndrome.</p> <p>Identify the types of fractures and those most common to your line of work. Learn how to prevent falls.</p>
<p><i>Understand</i> basic principles of ecology</p>	<p>Define ecology.</p> <p>Identify five major ways in which people interact with the environment, especially as relating to your industry.</p> <p>Discuss the effectiveness of the media as compared with 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>
<p><i>State</i> the differences between viruses and bacteria</p>	<p>Define viruses and bacteria. 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> <p>Explain the recent increased resistance to drugs and antibiotics.</p>
<i>Understand basic concepts relating to plants</i>	<p>Describe the interchange of oxygen and carbon dioxide between plants. Contrast it with the way humans exchange oxygen and carbon dioxide.</p> <p>As relating to industry, review the concepts of:</p> <ul style="list-style-type: none"> • Fertilization • Parts of a plant and functions of each • Effects of temperature on plants • Need for water and light • Photosynthesis
EARTH SCIENCE	
<i>Recognize earth's position in the universe</i>	<p>As relating to your industry, identify relevant topics regarding:</p> <ul style="list-style-type: none"> • Asteroids • Comets • Stars • Galaxies <p>Identify the planets in the solar system. Compare and contrast earth with other planets.</p> <p>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 ____).</p> <p>How do the phases of the moon and sun affect the hemispheres?</p>
<i>Investigate the history of the earth</i>	<p>Identify geological, chemical, and other methods of determining the age of an object.</p> <p>Demonstrate that fossils and rocks are indicators of previous eras.</p> <p>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. Assign each age to a group and</p>

	<p>research the following:</p> <ul style="list-style-type: none"> • Weather • Major events at beginning and end of age • Organisms living during this time • Factors that made the age unique
<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; movement 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. 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 ozone layer. Explain concepts of air pressure.</p>
<i>Understand basic principles of the solar system</i>	<p>Demonstrate how the sun strikes the earth at different angles depending on location.</p>

<p><i>Demonstrate the relationship between climate and weather</i></p>	<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>
<p><i>Learn and apply concepts relating to the oceans</i></p>	<p>Label the major oceans and seas. 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>
<p><i>Investigate principles of water</i></p>	<p>Identify the parts of the water cycle and the effects of the processes involved.</p> <p>Define water's chemical properties:</p> <ul style="list-style-type: none"> • Water is the universal solvent • Water has a neutral pH of 7 • Chemically, water is one atom of oxygen bound to two atoms of hydrogen <p>Measure salinity. Which industries rely heavily on water?</p>

	<p>Define water's physical properties:</p> <ul style="list-style-type: none"> • 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>	<p>As relating to your industry, discuss or debate the issues of:</p> <ul style="list-style-type: none"> • Allocation of resources • Recovering resources • Best/worst methods of using resources <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>
<p><i>Investigate issues regarding scientific technology</i></p>	<p>As relating to your industry, discuss the uses of technology. What are the newest developments? What effects does the technology have on our society? Political system? Discuss the role of economics on technology.</p>
<p><i>Apply science principles/laws to environmental issues</i></p>	<p>Discuss how humankind alters the earth and environment through pollution and the use of resources and technology.</p>

Crosswalk to SkillsUSA

Cabinetmaking

Purpose

To evaluate each contestant's preparation for employment and recognize outstanding students for excellence and professionalism in the field of cabinetmaking and millwork. First, refer to General Regulations, Page 9.

Clothing Requirement

Official SkillsUSA khaki work shirt and pants, black or brown leatherwork shoes, and 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 official work clothes, 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 career and technical programs with cabinetmaking and millwork as the occupational objective.

Safety Requirement

Both the instructors and the contestants certify by agreeing to enter this contest that the contestant has received instruction and has satisfactorily passed examination on the safe use of the following power equipment that may be used in the contest:

- Router radial arm saw table saw
- Jointer band saw drill press
- Hand drill scroll saw cutoff
- Saw disc and belt sander
- Baring machine

They also certify that SkillsUSA Inc. and the SkillsUSA Championships technical committee and national judges are released from all responsibility relating to personal injury resulting from

the use of the above-listed power equipment. Contestants will be removed from competition if proper training has not been provided and/or they are using the equipment in an unsafe manner.

Equipment and Materials

- Supplied by the technical committee:
 - All necessary power tools, equipment, and work stations for contestants
 - All necessary information and furnishings for judges and technical committee
- Supplied by the contestant:
 - Nail apron
 - Claw hammer
 - Measuring tape
 - Combination square
 - Two pencils
 - 1/32", 1/16", 3/32" nail sets
 - Block plane
 - Pocket knife/utility knife
 - Backsaw
 - Two 8" parallel jaw or "C" clamps
 - One set 1/4"-1" wood chisels
 - 10" or 12" mill bastard flat file
 - One set of flat blade and Phillips-head screwdrivers and/or handle with interchangeable bits
 - Sanding block
 - Hand scraper/cabinet scraper
 - Calculator

Note: No additional tools will be permitted.

Scope of the Contest

Contestants will be given all necessary information by job sheets or prints of articles to be constructed. Contestants will use joinery techniques as specified. Contestants will demonstrate their ability to perform jobs or skills selected from the following list of competencies as determined by the SkillsUSA Championships technical committee. Committee membership includes: Allen Millwork Co., Architectural Woodwork Institute, Black & Decker (U.S.) Inc., G&L Millwork, Powermatic Division, Louisville Lumber and Millwork Co. Inc., and Power Tool Institute Inc.

- Applying Wood Veneers and Plastic Laminates
 - Apply adhesives, edge banding, and wood edges
 - Apply laminate to core
 - Cut plastic to size
 - Fit plastic laminate joints
 - Trim edges
- Assembling, Fastening, and Installing Components
 - Apply clamping devices
 - Assemble drawers, panel door, and joint
 - Assemble ends, back, bracing, and face frame
 - Attach molding/trim
 - Fasten parts with nails, screws, and staples
 - Fasten top to casework
 - Glue boards edge to edge
 - Install catches, doors, drawer rail and guides, hinges, pulls and knobs, shelves, and track and slide for sliding doors
 - Reinforce joints with block/dowel.146 *SkillsUSA Championships Technical Standards (2002-2004)*
- Cutting and Shaping Components
 - Cut butt joint, counter top, dado/rabbet joint, doors, doweled joint, and drawer guides and runners (rails)
 - Cut drawer front, sides, back, and bottom
 - Cut ends, back, and interior bracing

- Cut face frame, miter joints, molding trim, mortise and tenon joints, frames and panels, shelving, spline joints, and tongue and groove joints
- Cut out for sink
- Edge (shape) counter top
- Plane stock
- Square solid stock
- Designing and Laying Out
 - Determine materials from a blueprint
 - Draw detailed plans
 - Estimate labor and material cost
 - Sketch shop plans
- Finishing Surfaces
 - Apply lacquers, paints, stains, varnishes/polyurethanes, and wood filler to nail or screw holes
 - Clean surfaces
 - Remove excess glue
 - Sand surfaces
 - Swell dents
- Transporting and Installing Cabinets
 - Fasten cabinet to wall
 - Trim cabinets
 - Prepare cabinets for transporting. *Sponsored by Goodheart-Willcox Publisher 147*

ITEMS EVALUATED

- Layout and overall measurements (a one-point penalty will be assessed for each 1/32" variance from print specifications)
- Machining operations
- Personal and general safety in work area
- Finished product assembly and construction (hammer marks, bent or protruding nails, chipped or broken edges, glue spots, dents or nicks, fit squareness, and general appearance. A one-point penalty will be assessed for each occurrence.)

- Accuracy
- Completed product

Note: An Oral Professional Assessment will be included. Points to be determined by national technical committee. 148 *SkillsUSA Championships Technical Standards (2002-2004)*.
Sponsored by Goodheart-Willcox Publisher 149

Arkansas' 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-rage or violent behavior
- Communicating safety regulations and plans to employees
- Working with selected community groups to implement safety programs

Furniture Manufacturing Technology Framework Cross Reference

Furniture Manufacturing I

Unit 1	Forest and Their Products	Duty(s): B, C
Unit 2	Classification and Characteristics of Trees and Lumber	Duty(s): A
Unit 3	Lumber	Duty(s): D, E, F
Unit 4	Measurement	Duty(s): K, L, M, N, O, Q
Unit 5	Bill of Materials	Duty(s): J, P, S
Unit 6	Hand Tools – Use & Safety	Duty(s): T, U
Unit 7	Cutting Joints with Hand Tools	Duty(s): U
Unit 8	Power Tools – Use & Safety	Duty(s): T, W, X, CC
Unit 9	Preparing Stock for Layout	Duty(s): Y
Unit 10	Layout and Joint Construction	Duty(s): CC
Unit 11	Sanding	Duty(s): Z
Unit 12	Fasteners	Duty(s): AA
Unit 13	Assembling Stock	Duty(s): DD
Unit 14	Finishing	Duty(s): EE

Furniture Manufacturing II

Unit 1	Review of Hand Tools – Use & Safety	Duty(s): T, U
Unit 2	Review of Power Tools – Use & Safety	Duty(s): T, W, X, CC
Unit 3	Design Principals of Furniture Making	Duty(s): G
Unit 4	Planning a Project with a Working Drawing	Duty(s): R
Unit 5	Bill of Materials	Duty(s): J, P, S
Unit 6	Assembling an Advanced Project	Duty(s): GG
Unit 7	Plastic Laminates	Duty(s): FF
Unit 8	Advanced Furnishing	Duty(s): EE
Unit 9	Careers in Furniture Making	Duty(s): HH