MASSACHUSETTS
DEPARTMENT of
EDUCATION

Vocational Technical Education Framework

Construction Cluster

Cabinetmaking

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Strand 1: Safety and Health Knowledge and Skills

1.A Define health and safety regulations.

- 1.A.01a Identify and apply OSHA and other health and safety regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.02a Identify and apply EPA and other environmental protection regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.03a Identify and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the occupational area.
- 1.A.04a Explain procedures for documenting and reporting hazards to appropriate authorities.
- 1.A.05a List penalties for non-compliance with appropriate health and safety regulations.
- 1.A.06a Identify contact information for appropriate health and safety agencies and resources.
- 1.A.07c Describe the history, function and importance of the Occupational Safety and Health Administration (OSHA).

1.B Demonstrate health and safety practices.

- 1.B.01a Identify, describe and demonstrate the effective use of Material Safety Data Sheets (MSDS).
- 1.B.02a Read chemical, product, and equipment labels to determine appropriate health and safety considerations .
- 1.B.03a Identify, describe and demonstrate personal, shop and job site safety practices and procedures .
- 1.B.04a Demonstrate safe dress and use of relevant safety gear and personal protective equipment (PPE), including wrist rests, adjustable workspaces and equipment, gloves, boots, earplugs, eye protection, and breathing apparatus.
- 1.B.05a Illustrate appropriate safe body mechanics, including proper lifting techniques and ergonomics.
- 1.B.06a Locate emergency equipment in your lab, shop, and classroom, including (where appropriate) eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches, and emergency exits.
- 1.B.07a Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop, and classroom.
- 1.B.08a Describe safety practices and procedures to be followed when working with and around electricity .
- 1.B.09a Properly handle, store, dispose of, and recycle hazardous, flammable, and combustible materials.
- 1.B.10a Demonstrate proper workspace cleaning procedures.
- 1.B.11c Identify and describe ladder and scaffold safety practices and procedures.
- 1.B.12c Identify and describe mechanical platform lift and material handling equipment safety practices and procedures.
- 1.B.13c Use and maintain fall arrest systems.
- 1.B.14c Identify and describe standard precautions for blood borne pathogens and the procedures for responding to and reporting exposure.

Performance Examples:

1. Toolbox safety talks are part of the weekly or daily instructional routine.
2. Students research a hazardous chemical/material used in the trade and make recommendation regarding appropriate precautions and use.
3. Developing and implementing a "Health and Safety Awareness Campaign" is assigned as a class project with students and/or teams of students responsible for different aspects/components including research, posters and multi-media presentations.
4. Students plan and put on a skit that mimics hazardous and unsafe environments and situations that could be encountered on the job site.

1.C Demonstrate responses to situations that threaten health and safety.

1.C.01a Illustrate First Aid procedures for potential injuries and other health concerns in the occupational area.

1.C.02a Describe the importance of emergency preparedness and an emergency action plan.

1.C.03a Illustrate procedures used to handle emergency situations and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures.

1.C.04a Identify practices used to avoid accidents.

1.C.05a Identify and describe fire protection, precautions and response procedures.

1.C.06a Discuss the role of the individual and the company/organization in ensuring workplace safety.

1.C.07a Discuss ways to identify and prevent workplace/school violence.

Strand 2: Technical Knowledge and Skills

2.A Read and interpret prints.

- 2.A.01c Explain the basic layout of a set of prints as well as the importance of the accompanying job specifications document.
- 2.A.02c Recognize and identify basic print terms, abbreviations, line types, symbols and notes.
- 2.A.03c Interpret and follow drawing dimensions.
- 2.A.04c Determine true measurements from a print using an Architect's scale.
- 2.A.05c Read and interpret plan, elevation, section and detail views and schedules.
- 2.A.06c Identify, develop and complete material quantity takeoff sheets.
- 2.A.07c Discuss how state and/or local code requirements apply to prints.
- 2.A.08 Read working drawings.
- 2.A.09 Read perspective drawings.
- 2.A.10 Read cabinet drawings.
- 2.A.11 Read shop drawings

Performance Examples:

1. Perform shop/job site projects/work from appropriate sets of prints/drawings.
2. Draw appropriate cross sections and/or details.
3. Develop a material quantity takeoff for the project/job.
4. Prepare an application for an appropriate permit.

2.B Demonstrate methods of measurement.

- 2.B.01 Read twelve inch rule in sixteenths.
- 2.B.02 Read Tape and stick measures.
- 2.B.03 Measure items using the combination, framing, and tri-square.
- 2.B.04 Measure items using dividers, calipers and trammel points.
- 2.B.05 Accurately measure wood components.

2.C Properly use hand tools.

- 2.C.01 Demonstrate safe operating procedures for hand tools.
- 2.C.02 Demonstrate use and maintenance of pounding tools.
- 2.C.03 Demonstrate use and maintenance of measuring tools.
- 2.C.04 Demonstrate use and maintenance of sawing tools.
- 2.C.05 Demonstrate use and maintenance of boring tools.
- 2.C.06 Demonstrate use and maintenance of sharp edge tools.
- 2.C.07 Demonstrate use and maintenance of prying tools.
- 2.C.08 Identify and use layout, measuring, and checking devices.
- 2.C.09 Identify metal working tools (hack saw and tin snips).

2.D Identify and install cabinetmaking joinery and mechanical fasteners.

- 2.D.01 Layout and fabricate a half lap.
- 2.D.02 Layout and fabricate a dovetail.
- 2.D.03 Layout and fabricate a French dovetail.
- 2.D.04 Layout and fabricate a haunched mortise and tenon.
- 2.D.05 Layout and fabricate a tongue and groove.
- 2.D.06 Layout and fabricate an end lap.
- 2.D.07 Layout and fabricate a miter.
- 2.D.08 Layout and fabricate a spline.

2.D.09 Layout and fabricate a bridle.
2.D.10 Layout and fabricate a dado.
2.D.11 Layout and fabricate a dowel joint.
2.D.12 Layout and fabricate a rabbet joint.
2.D.13 Identify types of cabinet joinery.
2.D.14 Identify application for cabinet joinery.
2.D.15 Fabricate cabinet joinery.
2.D.16 Machine tite-joint fasteners.
2.D.17 Install rail bolts.
2.D.18 Install bed rail fasteners.
2.D.19 Install Euro screws.

2.E Sand materials by hand.

2.E.01 Demonstrate flat sanding.
2.E.02 Demonstrate curved sanding.
2.E.03 Identify and select sand paper.
2.E.04 Identify hand sanding equipment and procedures.

2.F Apply adhesives to materials.

2.F.01 Identify types of glue.
2.F.02 Identify uses of glue.
2.F.03 Identify types of clamps.
2.F.04 Clamp a piece of furniture.
2.F.05 Demonstrate flat clamping procedures.
2.F.06 Demonstrate curved clamping procedures (layered).

2.G Estimate the costs of a project.

2.G.01 Compile a material takeoff.
2.G.02 Calculate a labor estimate.

2.H Properly layout a project.

2.H.01 Identify purposes of layout for woodwork.
2.H.02 Layout woodwork for fabrication.
2.H.03 Identify purposes for a story pole.
2.H.04 Create a story pole.

2.I List woodwork parts.

2.I.01 Identify components of material stock listing cards.
2.I.02 List woodwork components.

2.J Safely set up, operate and maintain power equipment relating to construction.

2.J.01 Set-up, adjust, and maintain a variety of pieces of power equipment.
2.J.02 Make a face, joint edge, rabbit, and taper by using a joiner.
2.J.03 Plane solid stock to given thickness using a planer.
2.J.04 Saw, re-saw, cut turnings, and change blades using a band saw.
2.J.05 Perform a plunge cut and cut an inside curve and bevel cut with a jig saw.
2.J.06 Perform a cross-cut, rip cut, mitre joint, and dado with a radial arm saw.

2.J.07 Perform a cross cut, dado, taper, and other specialized operations with a table saw.
2.J.08 Drill a hole to given dimensions with a drill press.
2.J.09 Drill Euro hinge cups according to standard procedures.
2.J.10 Demonstrate techniques to layout a mortise.
2.J.11 Cut a mortise and a relish with a mortise machine.
2.J.12 Summarize techniques needed to layout a tenon.
2.J.13 Demonstrate procedures used to fit checks for heel and toe on a tenoner.
2.J.14 Cut a tenon using a tenoner.
2.J.15 Grind sharp-edge tools with a grinder.
2.J.16 Demonstrate methods of preparing stock for use with a lathe.
2.J.17 Demonstrate preparation of turning chisels and duplicators.
2.J.18 Demonstrate methods of horizontal boring using a lathe.
2.J.19 Turn spindles on a lathe; match as required.
2.J.20 Demonstrate the ability to set up the guards and hold downs on a shaper.
2.J.21 Make a pattern cut using a shaper.
2.J.22 Identify different types of sanders.
2.J.23 Demonstrate the ability to set fences and stops on a sander as required.
2.J.24 Demonstrate the ability to set up for fitting miter joint when using a sander.
2.J.25 Smooth the surfaces of a variety of materials using a sander.
2.J.26 Identify and demonstrate the use of table, overhead, panel, and Computer Numerically Controlled routers.
2.J.27 Make cuts using an electric miter box saw, including adjusting stops.
2.J.28 Make rip, cross, and miter cuts using a panel saw.
2.J.29 Demonstrate the use of a 32mm Machine.
2.J.30 Demonstrate the use of a horizontal boring machine.
2.J.31 Demonstrate the use of an edge bander.
2.J.32 Demonstrate proper operation of a power feed.

2.K Properly use portable power tools.

2.K.01 Demonstrate the ability to use a pistol drill safely.
2.K.02 Identify the proper methods of using an oscillating sander.
2.K.03 Demonstrate the ability to use an electric router.
2.K.04 Exercise the safe use of a belt sander.
2.K.05 Demonstrate the ability to safely use a bayonet saw.
2.K.06 Identify the proper methods of using a circular saw.
2.K.07 Exercise the safe use of a biscuit joiner.
2.K.08 Demonstrate the ability to use an electric sander.
2.K.09 Explain the uses of wood boring bits.
2.K.10 Demonstrate methods of correctly using router cutters.
2.K.11 Identify blades, cutters, bits and grits of sandpaper required of stationary and portable power tools.

2.L Apply architectural woodwork quality standards.

2.L.01 Identify quality grades (premium, custom, economy, prevailing and exceptions to grade).
2.L.02 Identify the qualities of solid wood (AWI section 100).

2.L.03 Identify panel products (AWI section 200).
2.L.04 Explain the orientation of wood and wood products.
2.L.05 Identify laminates.
2.L.06 Identify solid surface materials.
2.L.07 Explain the purpose of moldings and what they are used for.
2.L.08 Identify plywood and composite materials.

2.M Apply Production Procedures and Techniques.

2.M.01 Design production system.
2.M.02 Design and build patterns and jigs.

2.N Fabricate Traditional and Modern Casework (wall, base and utility cabinets) (AWI Section 400).

2.N.01 Layout components.
2.N.02 Machine parts needed for casework.
2.N.03 Demonstrate proper cabinet assembly.
2.N.04 Machine a face frame when required.
2.N.05 Assemble a face frame.
2.N.06 Apply a face frame to cabinets.
2.N.07 Demonstrate how to prepare a cabinet for finish.
2.N.08 Identify design characteristics of cabinetry.
2.N.09 Identify layout and planning stages and procedures.
2.N.10 Identify casework construction (five types of cabinet construction per AWI).
2.N.11 Identify 32mm European construction.
2.N.12 Illustrate kitchen cabinets, both stock and custom.
2.N.13 Illustrate modular casework (AWI section 1600).
2.N.14 Illustrate drawer construction.
2.N.15 Demonstrate the installation of drawers.
2.N.16 Illustrate door construction.
2.N.17 Demonstrate proper hanging of doors.
2.N.18 Apply Architectural Woodworking Institute Quality Standards to casework construction.

2.O Fabricate Furniture.

2.O.01 Layout components of a piece of furniture.
2.O.02 Machine parts of a piece of furniture.
2.O.03 Assemble parts.
2.O.04 Prepare for finish.
2.O.05 Identify frame and panel construction.
2.O.06 Illustrate drawer construction.
2.O.07 Illustrate leg and rail construction.
2.O.08 Illustrate door construction.
2.O.09 Describe gluing and clamping techniques.
2.O.10 Identify fasteners.
2.O.11 Identify hardware.
2.O.12 Describe sanding operations.
2.O.13 Apply Architectural Woodworking Institute Quality Standards to furniture construction.

2.P Apply Hardware.

2.P.01 Identify types, finishes, and mechanisms of hardware.
2.P.02 Apply hinges to cabinet doors.
2.P.03 Apply pulls to cabinet doors and drawers.
2.P.04 Apply drawer slides.
2.P.05 Apply catches and latches.
2.P.06 Apply shelf standards and shelf pins.
2.P.07 Apply locks.

2.Q Fabricate Standing and Running Trim (AWI section 300, includes AWI section 900, frames and jambs).

2.Q.01 Identify standing and running custom trim.
2.Q.02 Identify custom rails (commercial corridor).
2.Q.03 Explain “knife cuts per inch” to indicate smoothness of flat moulded surfaces.
2.Q.04 Illustrate radius mouldings.
2.Q.05 Illustrate frames and jambs (interior, exterior frames and jambs, sidelight, louver, transom, and borrowed light jambs and their fire ratings).
2.Q.06 Fabricate trim and mouldings according to given designs and specifications.
2.Q.07 Join pieces of moulding (both to extend a run and create a corner).
2.Q.08 Apply Architectural Woodwork Institute Quality Standards to trim construction.

2.R Fabricate Paneling and Related Wood Doors (AWI section 500).

2.R.01 Identify flush, flush laminate, stile and rail paneling.
2.R.02 Identify possible panel (veneer) matches (internal veneer leaves and adjacent panels).
2.R.03 Identify panel joints and transitions.
2.R.04 Identify applied mouldings.
2.R.05 Identify components of stile and rail paneling.
2.R.06 Apply Architectural Woodworking Institute Quality Standards to panel construction.

2.S Fabricate Counters (AWI section 400).

2.S.01 Identify panel product tops (veneer).
2.S.02 Identify high-pressure decorative laminate tops.
2.S.03 Identify post – formed high-pressure decorative laminate tops.
2.S.04 Identify combination material tops.
2.S.05 Identify solid surface materials.
2.S.06 Identify solid laminated tops.
2.S.07 Identify solid wood tops.
2.S.08 Identify epoxy resin tops.
2.S.09 Identify possible problem areas and corrective measures for tops.
2.S.10 Demonstrate counter top joinery.
2.S.11 Fabricate counters and countertops according to given designs and specifications.
2.S.12 Apply Architectural Woodworking Institute Quality Standards to counter top construction.

2.T Install closet and utility shelving (AWI section 600).

- 2.T.01 Identify deflection.
- 2.T.02 Identify hardware used in closet and utility shelving.
- 2.T.03 Identify joinery.
- 2.T.04 Fabricate closet and utility shelving according to given designs and specifications.
- 2.T.05 Apply Architectural Woodworking Institute Quality Standards for shelf construction.

2.U Fabricate ornamental woodwork (AWI section 700).

- 2.U.01 Illustrate pediment heads.
- 2.U.02 Illustrate mantels.
- 2.U.03 Illustrate ornamental grills.
- 2.U.04 Illustrate fluted pilasters.
- 2.U.05 Illustrate cupolas.
- 2.U.06 Illustrate finials.
- 2.U.07 Illustrate corbels.
- 2.U.08 Illustrate balusters.
- 2.U.09 Illustrate posts and columns.
- 2.U.10 Identify fire-retardant products.
- 2.U.11 Identify column orders.
- 2.U.12 Fabricate ornamental woodwork according to given designs and specifications.
- 2.U.13 Apply Architectural Woodworking Institute Quality Standards for ornamental woodwork construction.

2.V Install stairwork and rails (AWI section 800).

- 2.V.01 Identify stair and rail parts and associated hardware.
- 2.V.02 Define rise, run, and headroom.
- 2.V.03 Explain housed and open stringers.
- 2.V.04 Explain considerations when working with curved / circular stairs.
- 2.V.05 Fabricate stairwork and rails according to given designs and specifications.
- 2.V.06 Apply Architectural Woodworking Institute Quality Standards for stair and rail construction.

2.W Install windows (AWI section 1000).

- 2.W.01 Define types of glazing.
- 2.W.02 Identify materials and quality required for different grades.
- 2.W.03 Identify characteristics of double hung windows.
- 2.W.04 Identify characteristics of hopper windows.
- 2.W.05 Identify characteristics of tilt / turn windows.
- 2.W.06 Identify characteristics of casement windows.
- 2.W.07 Identify characteristics of awning windows.
- 2.W.08 Identify characteristics of sidelights.
- 2.W.09 Identify characteristics of clerestory windows.
- 2.W.10 Identify characteristics of fixed windows.
- 2.W.11 Identify circular head.
- 2.W.12 Machine and fabricate sash parts, frames, and joinery according to given designs and specifications.
- 2.W.13 Apply Architectural Woodworking Institute Quality Standards to window construction.

2.X Fabricate Wood Screens (AWI section 1100).

- 2.X.01 Describe insect screens for window and door openings.
- 2.X.02 Identify materials and quality required for different grades.
- 2.X.03 Install screens according to given designs and specifications.
- 2.X.04 Apply Architectural Woodworking Institute Quality Standards for wood screen construction.

2.Y Fabricate Blinds and Shutters (AWI section 1200).

- 2.Y.01 Identify materials and quality required for different grades.
- 2.Y.02 Identify shutter styles.
- 2.Y.03 Illustrate slat joinery.
- 2.Y.04 Identify panel styles.
- 2.Y.05 Identify blind and shutter joinery.
- 2.Y.06 Describe the function of a control rod.
- 2.Y.07 Fabricate blinds and shutters according to given designs and specifications.
- 2.Y.08 Apply Architectural Woodworking Institute Quality Standards for blind and shutter construction.

2.Z Install architectural flush doors (AWI section 1300).

- 2.Z.01 Identify types of flush door cores.
- 2.Z.02 Identify edge treatments.
- 2.Z.03 Identify different types of veneer and methods of matching grain.
- 2.Z.04 Describe door machining.
- 2.Z.05 Apply Architectural Woodworking Institute Quality Standards for flush door construction (this task listing excludes pre-manufactured stock flush door units).

2.AA Fabricate Stile and Rail Doors (AWI section 1400).

- 2.AA.01 Illustrate stile and rail joinery.
- 2.AA.02 Describe panel construction techniques.
- 2.AA.03 Identify fire ratings.
- 2.AA.04 Identify associated mouldings.
- 2.AA.05 Explain door machining.
- 2.AA.06 Fabricate and install stile and rail doors according to given designs and specifications.
- 2.AA.07 Apply Architectural Woodworking Institute Quality Standards for stile and rail doors.

2.BB Install woodwork (AWI section 1700).

- 2.BB.01 Identify blocking, cleats, and interlocking cleats.
- 2.BB.02 Identify fasteners.
- 2.BB.03 Define plumb and level.
- 2.BB.04 Explain scribe.
- 2.BB.05 Install woodwork according to given designs and specifications.

2.CC Finish woodwork.

- 2.CC.01 Define finish terminology.
- 2.CC.02 Explain transparent finish systems.
- 2.CC.03 Explain opaque finish systems.
- 2.CC.04 Define stain.
- 2.CC.05 Explain treatment of sapwood.
- 2.CC.06 Contrast exposed, semi-exposed, and back priming.
- 2.CC.07 Finish materials according to given designs and specifications.
- 2.CC.08 Apply Architectural Woodworking Institute Quality Standards for finish.

Strand 3: Embedded Academic Knowledge and Skills

3.A English Language Arts

VTE #	Acad #	Standard	Grade	Topic
3.A.01c	19.21	For informational/expository writing: Write reports based on research that include quotations, footnotes or endnotes, and a bibliography.	Pre-9th	Composition
3.A.02c	24.4	Apply steps for obtaining information from a variety of sources, organizing information, documenting sources, and presenting research in individual projects:	Pre-9th	Composition
3.A.03c	13.19	Identify and use knowledge of common graphic features (charts, maps, diagrams).	Pre-9th	Reading
3.A.04c	2.4	Integrate relevant information gathered from group discussions and interviews for reports.	Pre-9th	Language
3.A.05c	3.17	Deliver formal presentations for particular audiences using clear enunciation and appropriate organization, gestures, tone, and vocabulary.	11/12	Language
3.A.06c	4.27	Use general dictionaries, specialized dictionaries, thesauruses, histories of language, books of quotations, and other related references as needed.	11/12	Language
3.A.07c	19.27	For informational/expository writing: Write well-organized research papers that prove a thesis statement using logical organization, effective supporting evidence, and variety in sentence structure.	11/12	Composition
3.A.08c		Follow correct procedures for technical documentation.		Voc
3.A.09c		Read technical manuals, guides, resource books and technical literature to gain information and solve problems.		Voc
3.A.10c		Read, comprehend, and follow written technical directions for repairs, procedures and processes.		Voc

3.B Mathematics

VTE #	Acad #	Standard	Grade	Topic
3.B.01c	7.G.5	Use a ruler, protractor, and compass to draw polygons and circles.	Pre-9th	Geometry
3.B.02c	7.M.2	Given the formulas, convert from one system of measurement to another. Use technology as appropriate.	Pre-9th	Measurement
3.B.03c	7.P.4	Solve linear equations using tables, graphs, models, and algebraic methods.	Pre-9th	Patterns, relations, algebra
3.B.04c	8.N.1	Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents.	Pre-9th	Numbers
3.B.05c	10.G.3	Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.	9/10	Geometry
3.B.06c	10.G.8	Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the "point-slope" form of the equation.	9/10	Geometry
3.B.07c	10.G.10	Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.	9/10	Geometry
3.B.08c	10.M.1	Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.	9/10	Measurement
3.B.09c	10.P.8	Solve everyday problems that can be modeled using systems of linear equations or inequalities. Apply algebraic and graphical methods to the solution. Use technology when appropriate. Include mixture, rate, and work problems.	9/10	Patterns, relations, algebra
3.B.10c	12.G.5	Apply properties of angles, parallel lines, arcs, radii, chords, tangents, and secants to solve problems.	9/10	Geometry

3.B.11c	12.M.2	Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense.	11/12	Measurement
3.B.12	10.N.4	Use estimation to judge the reasonableness of results of computations and of solutions to problems involving real numbers.	9/10	Numbers
3.B.13	10.P.2	Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.	9/10	Patterns, relations, algebra
3.B.14	10.G.1	Identify figures using properties of sides, angles, and diagonals. Identify the figures' type(s) of symmetry.	9/10	Geometry
3.B.15	10.G.2	Draw congruent and similar figures using a compass, straightedge, protractor, and other tools such as computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.	9/10	Geometry
3.B.16	10.G.5	Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean theorem.	9/10	Geometry
3.B.17	12.P.8	Solve a variety of equations and inequalities using algebraic, graphical, and numerical methods, including the quadratic formula; use technology where appropriate. Include polynomial, exponential, logarithmic, and trigonometric functions; expressions involving absolute values; trigonometric relations; and simple rational expressions.	11/12	Patterns, relations, algebra
3.B.18	12.P.9	Use matrices to solve systems of linear equations. Apply to the solution of everyday problems.	11/12	Patterns, relations, algebra

3.B.19	12.P.12	Relate the slope of a tangent line at a specific point on a curve to the instantaneous rate of change. Identify maximum and minimum values of functions in simple situations. Apply these concepts to the solution of problems.	11/12	Patterns, relations, algebra
3.B.20	12.G.4	Relate geometric and algebraic representations of lines, simple curves, and conic sections.	11/12	Geometry
3.B.21		Define 6-4-10 method of calculation.		Voc
3.B.22		Layout an ellipse.		Voc

3.C Science and Engineering/Technology

VTE #	Acad #	Standard	Grade	Topic
3.C.01c	1	Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.	Pre-9th	Physics/Chem
3.C.02c	3	Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (e.g., rulers, graduated cylinders, balances) and knowledge and appropriate use of significant digits.	Pre-9th	Physics/Chem
3.C.03c	9.3	Identify the factors that affect the rate of a chemical reaction (temperature, concentration) and the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).		Chemistry
3.C.04c	11.1	Describe the chemical processes known as oxidation and reduction.		Chemistry
3.C.05c	1.3	Describe the characteristics of waves (wavelength, frequency, velocity, amplitude).		Earth/Space
3.C.06c	1.1	Identify and explain the steps of the engineering design process, i.e., identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign.		Eng/Tech
3.C.07c	2.1	Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.		Eng/Tech

3.C.08c	2.2	Identify and explain the purposes of common tools and measurement devices used in construction, e.g., spirit level, transit, framing square, plumb bob, spring scale, tape measure, strain gauge, venturi meter, pitot tube.		Eng/Tech
3.C.09c	2.3	Describe how structures are constructed using a variety of processes and procedures, e.g., welds, bolts, and rivets are used to assemble metal framing materials.		Eng/Tech
3.C.10c	2.4	Identify and explain the engineering properties of materials used in structures, e.g., elasticity, plasticity, thermal conductivity, and density.		Eng/Tech
3.C.11c	2.5	Differentiate the factors that affect the design and building of structures, such as zoning laws, building codes, and professional standards.		Eng/Tech
3.C.12c	2.6	Calculate quantitatively the resultant forces for live loads and dead loads.		Eng/Tech
3.C.13c	4.1	Differentiate among conduction, convection, and radiation in a thermal system, e.g., heating and cooling a house, cooking.		Eng/Tech
3.C.14c	4.2	Give examples of how conduction, convection, and radiation are used in the selection of materials, e.g., home and vehicle thermostat designs, circuit breakers.		Eng/Tech
3.C.15c	5.3	Explain the relationship between resistance, voltage, and current (Ohm's Law).		Eng/Tech
3.C.16c	5.5	Identify appropriate units of measurement for current, voltage, and resistance, and explain how they are measured.		Eng/Tech
3.C.17c	5.6	Analyze circuits (find the current at any point and the potential difference between any two points in the circuit) using Kirchoff and Ohm's laws.		Eng/Tech
3.C.18c	1.1	Distinguish between vector quantities (velocity, acceleration, and force) and scalar quantities (speed and mass).		Physics
3.C.19c	1.3	Distinguish between, and solve problems involving, velocity, speed, and constant acceleration.		Physics

3.C.20c	1.4	Create and interpret graphs of motion (position vs. time, speed vs. time, velocity vs. time, constant acceleration vs. time).		Physics
3.C.21c	1.5	Explain the relationship between mass and inertia.		Physics
3.C.22c	1.7	Interpret and apply Newton's second law of motion to show how an object's motion will change only when a net force is applied.		Physics
3.C.23c	2.3	Apply quantitatively the law of conservation of mechanical energy to simple systems.		Physics
3.C.24c	2.4	Describe the relationship among energy, work, and power both conceptually and quantitatively.		Physics
3.C.25c	2.6	Identify appropriate standard international units of measurement for energy, work, power, and momentum.		Physics
3.C.26c		Calculate heat load, using K, R and U factors.		Voc
3.C.27c		Explain the concept of BTU.		Voc
3.C.28c		Define and interpret elevation and topography components in drawings and technical documents.		Voc
3.C.29	5.5	Calculate mass-mass, mass-volume, volume-volume, and limiting reactant problems for chemical reactions.		Chemistry
3.C.30	1.2	Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective) using proper techniques.		Eng/Tech
3.C.31	1.3	Demonstrate the use of drafting techniques with paper and pencil or computer-aided design (CAD) systems when available.		Eng/Tech
3.C.32	1.4	Apply scale and proportion to drawings, e.g., 1/4" = 1'0".		Eng/Tech
3.C.33	1.5	Interpret plans, diagrams, and working drawings in the construction of a prototype.		Eng/Tech
3.C.34	3.1	Differentiate between open (e.g., irrigation, forced hot air system) and closed (e.g., forced hot water system, hydroponics) fluid systems and their components such as valves,		Eng/Tech

		controlling devices, and metering devices.		
3.C.35	3.2	Identify and explain sources of resistance (e.g., 45deg. elbow, 90deg. elbow, type of pipes, changes in diameter) for water moving through a pipe.		Eng/Tech
3.C.36	3.3	Explain Bernoulli's Principle and its effect on practical applications, i.e., airfoil design, spoiler design, carburetor.		Eng/Tech
3.C.37	3.5	Explain the relationship between velocity and cross-sectional areas in the movement of a fluid.		Eng/Tech
3.C.38	3.6	Solve problems related to hydrostatic pressure and depth in fluid systems.		Eng/Tech
3.C.39	1.1	Distinguish between vector quantities (velocity, acceleration, and force) and scalar quantities (speed and mass).		Physics
3.C.40	1.5	Explain the relationship between mass and inertia.		Physics
3.C.41	2.1	Interpret and provide examples that illustrate the law of conservation of energy.		Physics
3.C.42	2.2	Provide examples of how energy can be transformed from kinetic to potential and vice versa.		Physics
3.C.43	2.3	Apply quantitatively the law of conservation of mechanical energy to simple systems.		Physics
3.C.44	2.4	Describe the relationship among energy, work, and power both conceptually and quantitatively.		Physics
3.C.45	2.5	Interpret the law of conservation of momentum and provide examples that illustrate it. Calculate the momentum of an object.		Physics
3.C.46	2.6	Calculate quantitatively the resultant forces for live loads and dead loads.		Physics
3.C.47	3.2	Differentiate between specific heat and heat capacity.		Physics
3.C.48	3.3	Explain the relationship among temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.		Physics

3.C.49	5.4	Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them.		Physics
3.C.50	1.1	Identify the earth's principal sources of internal and external energy, e.g., radioactive decay, gravity, solar energy.		Earth/Space
3.C.51	3.7	Compare and contrast the processes of the hydrologic cycle including evaporation, condensation, precipitation, surface runoff and groundwater percolation, infiltration, and transpiration.		Earth/Space
3.C.52		Describe different aspects of material content and composition that effect strength, use, conductivity, etc.		Voc
3.C.53		Describe the effects of humidity, weather, and chemical substances have on wood and building materials.		Voc
3.C.54		Define the physical properties of wood, grain structures and decay.		Voc
3.C.55		Conduct investigations to gain evidence that interaction of matter with electromagnetic radiation, electricity, and heat.		Voc

Strand 4: Employability Knowledge and Skills

4.A Develop employability skills to secure and keep employment in chosen field.

- 4.A.01a Evaluate industries, organizations, and careers based on multiple sources of research and information.
- 4.A.02a Assess interest areas to determine potential career pathways, including career ladders.
- 4.A.03a Develop a career plan with alternatives.
- 4.A.04a Complete job applications and related employment documents (e.g. W-4).
- 4.A.05a Create professional cover letters, resumes, and portfolios in a variety of formats (print and electronic) .
- 4.A.06a Apply job search skills to seek, evaluate, apply for, and accept employment.
- 4.A.07a Demonstrate good interviewing skills.
- 4.A.08a Demonstrate employability skills needed to get and keep a job.
- 4.A.09a Assess alternative occupational choices (e.g. working conditions, benefits, and opportunities to change).

Performance Examples:

1. Research positions open within a variety of companies and compare/contrast their descriptions, duties, and expectations.
2. Prepare responses to standard interview questions.
3. Participate in a mock-interview with industry professionals.

4.B Communicate in multiple modes to address needs within the career and technical field.

- 4.B.01a Apply strategies to enhance effectiveness of all types of communications in the workplace.
- 4.B.02a Apply reading skills and strategies to work-related documents.
- 4.B.03a Locate information from books, journals, magazines, and the Internet.
- 4.B.04a Apply basic writing skills to work-related communication.
- 4.B.05a Write work-related materials.
- 4.B.06a Explain information presented graphically.
- 4.B.07a Use writing/publishing/presentation applications.
- 4.B.08a Apply basic skills for work-related oral communication.
- 4.B.09a Explain proper telephone etiquette and skills .
- 4.B.10a Lead formal and informal group discussions.
- 4.B.11a Demonstrate effective negotiation and conflict management.
- 4.B.12a Apply active listening skills to obtain and clarify information.
- 4.B.13a Communicate with others in a diverse workforce.

Performance Examples:

1. Review a professional journal; choose one article to summarize.
2. Call the publisher for free products in journal.
3. Develop an oral presentation regarding an article in a journal.
4. Summarize trends presented in a graph.

4.C Solve problems using critical thinking.

- 4.C.01a Demonstrate skills used to define and analyze a given problem.

4.C.02a Explain the importance and dynamics of individual and teamwork approaches of problem solving.
4.C.03a Describe methods of researching and validating reliable information relevant to the problem.
4.C.04a Explain strategies used to formulate ideas, proposals and solutions to problems.
4.C.05a Select potential solutions based on reasoned criteria.
4.C.06a Implement and evaluate solution(s).

4.D Demonstrate positive work behaviors.

4.D.01a Identify time management and task prioritization skills.
4.D.02a Explain the importance of following workplace etiquette/protocol.
4.D.03a Demonstrate willingness to learn and further develop skills.
4.D.04a Demonstrate self-management skills.
4.D.05a List causes of stress and effective stress management techniques.
4.D.06a Describe the importance of having a positive attitude and techniques that boost morale.
4.D.07a Show initiative by coming up with unique solutions and taking on extra responsibilities.
4.D.08a Explain the importance of setting goals and demonstrate the ability to set, reach, and evaluate goals.
4.D.09a Explain the importance of taking pride in work accomplished and extrinsic and intrinsic motivators that can be used to increase pride.
4.D.10a Value the importance of professionalism, including reliability, honesty, responsibility, and ethics.
4.D.11a Demonstrate a respect for diversity and its benefit to the workplace.

Strand 5: Management and Entrepreneurship Knowledge and Skills

5.A Analyze basic business practices required to start and run a company/organization.

5.A.01a Define entrepreneurship .
5.A.02a Describe the relationship between suppliers, producers, and consumers.
5.A.03a Compare and contrast types of businesses, including sole proprietorships, small businesses, companies, corporations, governmental agencies, and non-profit organizations.
5.A.04a Describe practices that ensure quality customer service.
5.A.05a Explain the value of competition in business/field.

Performance Examples:

1. Prepare a business plan for a new company in your community.
2. Participate in a discussion with members of a local small-business incubator or chamber of commerce, identifying opportunities and summarizing best practices of new companies.
3. Create an equipment list, with costs, of equipment required for doing specific tasks.
4. Identify local zoning and environmental laws that apply to businesses in your industry.

5.B Manage all resources related to a business/organization.

5.B.01a Identify a company's/organization's chain of command and organizational structure.
5.B.02a Define and demonstrate leadership and teamwork skills.
5.B.03a Explain ways a company or organization can market itself, including choosing a name, designing logos and promotional materials, advertising, and the importance of word-of-mouth.
5.B.04a Identify methods to track inventory, productivity, income, expenses, and personnel .
5.B.05a Explain the importance of written operating procedures and policies.
5.B.06a Identify professional organizations and their benefits.
5.B.07a Explain methods to effectively run a meeting.
5.B.08 Examine all aspects of the built environment and its systems to complete the project.
5.B.09 Explain the value of industry standards and practices to gain an appreciation for quality workmanship.

Performance Examples:

1. Create a plan to keep track of tools and supplies in your classroom/shop.
2. Work as a team to complete a project, including running and participating in problem-solving meetings.
3. Contact a relevant professional organization and request information about its benefits, membership requirements, and costs.
4. Clip print advertisements from local companies, identifying common themes and contrasting different styles.

5.C Describe methods for managing, organizing, retrieving and reporting financial data.

5.C.01a Explain the role of small businesses in the economy.

5.C.02a Extract and extrapolate data from financial documents, such as a pay-stub, budget, tax statement, and financial report.

Performance Examples:

1. Create and follow a budget for an in-class project.
2. Identify equipment in your shop/lab that are considered as capital.
3. From a pay-stub, determine gross salary, deductions, and net pay for a calendar year.
4. Create a rate card or other list of standardized costs for services provided, based on research of local rates and practices.

5.D Apply labor and civil rights law and guidelines to business practice and decisions.

5.D.01a List federal and state mandated employee rights.

5.D.02a Describe proper working conditions for your industry.

5.D.03a Explain the role of labor organizations.

5.D.04a Discuss the importance of diversity and list methods of encouraging diversity in the workplace.

5.D.05a Describe standard forms of employment contracts applicable to your industry.

5.D.06a State the current minimum wage, as well as wages for common jobs found within the field.

5.D.07a List opportunities for continual professional development.

Performance Examples:

1. Participate in and summarize a discussion with a member of a labor organization.
2. Participate in and summarize a discussion with a member of a civil rights organization.
3. While participating in a group project, write and follow job descriptions for each member of the team.
4. Evaluate a shop/lab in terms of safety, ergonomics, and workflow.

5.E Evaluate the effects of community relations on companies and the industry.

5.E.01a Describe the role that the industry/organization plays in different communities.

5.E.02a Describe the role that community interests play in a company's/organization's decision-making process.

Performance Example:

1. Participate in a service project or community-centered event.

5.F Apply legal requirements and ethical considerations to business practice and decisions.

5.F.01a Identify laws that regulate businesses/organizations in your field.

5.F.02a Define the requirements for and protections given by copyright and trademark law.

5.F.03a Define the impact of the Americans with Disabilities Act and other civil rights legislation on your business/organization, employees, and customers.

5.F.04a I Define ethical business practices for your field.

5.F.05a Identify trade-specific practices that support clean energy technologies and encourage environmental sustainability.

Performance Examples:

1. Research the ethical guidelines set forth by a professional organization related to your industry and participate in a debate over how to apply these guidelines to a variety of situations.
2. Create a portfolio of a variety of completed contracts and their uses.
3. Participate in and summarize a discussion with a lawyer, consumer advocate, or other legal professional.
4. Create a quick reference outline listing legal topics and related resources.

Strand 6: Technological Knowledge and Skills

6.A Demonstrate proficiency in the use of computers and applications as well as an understanding of concepts underlying hardware, software, and connectivity.

6.A.01a Select and utilize the appropriate technology to solve a problem or complete a task.
6.A.02a Demonstrate file management skills (e.g., install new software, compress and expand files as needed, download files as appropriate).
6.A.03a Differentiate between different operating systems and demonstrate use of at least one to open and switch between programs and files.
6.A.04a Identify and demonstrate resolutions to simple hardware and software problems as they occur (e.g., frozen screen, disk error, printing problems).
6.A.05a Save, retrieve, load, format, and import data into, and export a variety of electronic documents (word processing, spreadsheet, database, AND desktop publishing).
6.A.06a Demonstrate the proper use of a variety of external peripherals and how they connect to a computer.
6.A.07a Illustrate methods of selecting and using search engines.
6.A.08a Send, receive, and manage electronic correspondence and files, in accordance with school policy.
6.A.09a Demonstrate proper use of electronic proofreading tools and explain reasons why these shouldn't be relied upon solely.
6.A.10c Operate computer-driven equipment and machines.
6.A.11c Use installation and operation manuals.
6.A.12c Troubleshoot equipment and machines and access support as needed.
6.A.13 Use a Computer Aided Design (CAD) system to perform drafting duties.

Performance Example:

1. In the development of work-based projects, students demonstrate computer skills inherent in the word processing techniques used, the organization of data, use of photographic representation, research projects, and other relevant project based activities.

6.B Demonstrate responsible use of technology and an understanding of ethics and safety issues in using electronic media.

6.B.01a Identify ways in which technology is used in the workplace and in society.
6.B.02a Summarize the rights and responsibilities of the school's Acceptable Use Policy.
6.B.03a Explain laws restricting use of copyrighted materials on the Internet.
6.B.04a Discuss the concerns about electronic communications, privacy and security, including protection from spyware and viruses.

Performance Example:

1. Describe how computers are used to increase efficiency, accuracy, and professionalism in the industry.

6.C Demonstrate ability to use technology for research, problem solving, and communication.

6.C.01a Locate, evaluate, collect, and process information from a variety of electronic sources .

6.C.02a Demonstrate the use of telecommunications and other media to interact or collaborate with peers, experts, and other audiences.

6.C.03a Demonstrate the use of appropriate electronic sources to conduct research (e.g., Web sites, online periodical databases, and online catalogs).

6.C.04a Demonstrate proper style (with correct citations) when integrating electronic research results into a research project.

6.C.05a Collect, organize, analyze, and graphically present data using the most appropriate tools.

6.C.06a Present information, ideas, and results of work using any of a variety of communications technologies (e.g., multimedia presentations, Web pages, videotapes, desktop-published documents).

6.C.07a Identify capabilities of technology resources and describe how they can be used for lifelong learning.

6.C.08a Demonstrate the proper use of electronic tools and office communications equipment (telephone, fax, copier, etc).

6.C.09c Demonstrate the use a variety of industry specific software.

6.C.10c Facilitate group work through management of shared schedule and contact information.

Performance Example:

1. Student is able to effectively use various technologies in the workplace.