



MASSACHUSETTS
DEPARTMENT of
EDUCATION

**Vocational Technical Education
Framework**

Construction Cluster

Painting and Design Technologies

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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 Interpret the symbols on a plot plan, foundation/basement plan, foot plan, exterior elevation, electrical plan, and a construction detailed drawing.

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 Investigate careers in painting and design.

- 2.B.01 Explain objectives of apprenticeship program.
- 2.B.02 List various career options within the housing fields.
- 2.B.03 Compare the duties and educational requirements of various occupations related to housing.
- 2.B.04 Describe the history of painting and design technology.

Performance Example:

1. Have a guest speaker from the painting trade and the design trade.

2.C Apply the fundamentals of housing and evaluate floor plans.

- 2.C.01 Describe the factors which affect housing choices.
- 2.C.02 Explain the relationships between lifestyle and housing choices.
- 2.C.03 Describe the main types of housing.
- 2.C.04 Compare the strengths and weaknesses of the different types of housing.
- 2.C.05 Map a circulation pattern and evaluate its quality.
- 2.C.06 Identify the specific activities and areas involved in family circulation, work circulation, service circulation, and guest circulation.
- 2.C.07 Determine the utility of a floor plan in relationship to family needs.
- 2.C.08 Identify the seven types of drawings included in a set of house plans and explain their purposes.

2.D Prepare and apply surface substrates and materials.

- 2.D.01 Describe preparation tools & materials.
- 2.D.02 Identify surface substrates in construction.
- 2.D.03 Identify surface conditions of substrates.
- 2.D.04 Perform basic surface preparation.
- 2.D.05 Describe or demonstrate preparation methods.
- 2.D.06 Demonstrate general preparations for various substrates.

- 2.E Demonstrate procedures to protect adjacent surfaces.**
- 2.E.01 Describe tools and materials for protecting surfaces.
 - 2.E.02 Describe or demonstrate methods of applying masking to various surfaces.
 - 2.E.03 Demonstrate proper clean up of adjacent surfaces.
- 2.F Compare and contrast paints, coatings, and sealants.**
- 2.F.01 Explain function of pigments, resins, solvents & additives.
 - 2.F.02 Describe basic differences of oil based and water based coatings.
 - 2.F.03 Describe the properties and functions of paints and coatings.
 - 2.F.04 Demonstrate methods of clean-up and disposal of paints.
 - 2.F.05 Describe composition of various sealants.
 - 2.F.06 Describe tools required for sealant application.
 - 2.F.07 Apply fillers to an inside corner between two substrates.
 - 2.F.08 Explain why alkali-resistant coatings are used on masonry and plaster products.
- 2.G Apply paints and coatings.**
- 2.G.01 Recognize various types of brushes and select proper brushes for different jobs.
 - 2.G.02 Recognize and select various rollers and roller covers.
 - 2.G.03 Demonstrate proper application with brush or roller.
 - 2.G.04 Demonstrate proper method of painting a panel door.
 - 2.G.05 Demonstrate proper method of painting a double hung window.
- 2.H Identify paint failures and recommend remedies.**
- 2.H.01 Recognize physical symptoms of various coating failures.
 - 2.H.02 State causes of specific types of paint failures.
 - 2.H.03 Describe appropriate method of correcting specified failures.
 - 2.H.04 Describe improper batching or paint formulation.
 - 2.H.05 Describe unanticipated exposure condition that can cause paint failure.
 - 2.H.06 Describe curing under adverse temperatures or moist conditions.
- 2.I Apply the stages of planning jobs.**
- 2.I.01 Demonstrate general procedure for estimating a job.
 - 2.I.02 Develop a detailed schedule to complete a job.
 - 2.I.03 Determine quantities of paint and materials for a job.
 - 2.I.04 Explain how to price general painting costs.
 - 2.I.05 Demonstrate the ability to price preparation cost.
 - 2.I.06 Explain how to price industrial and heavy commercial painting cost.
 - 2.I.07 Demonstrate how to price wall covering cost.
- 2.J Properly use chemical strippers and low pressure water cleaning.**
- 2.J.01 Identify and properly use cleaners and strippers.
 - 2.J.02 Explain hazards associated with cleaners & strippers.
 - 2.J.03 Demonstrate general methods of use with cleaners and strippers.
 - 2.J.04 Demonstrate the proper use of power washers.

- 2.K Finish and patch drywall.**
- 2.K.01 Identify drywall finishing tools.
 - 2.K.02 Identify materials used in drywall finish.
 - 2.K.03 Demonstrate ability to patch damaged drywall.
 - 2.K.04 Demonstrate the ability to properly finish drywall using hand tools.
- 2.L Describe and apply stains, clear finishes, and wood finishing .**
- 2.L.01 Describe difference between stains and other coatings.
 - 2.L.02 Describe difference between dye and pigmented stains.
 - 2.L.03 Identify application considerations unique to stains.
 - 2.L.04 Describe types of clear finishes.
 - 2.L.05 Apply clear finish by hand.
 - 2.L.06 Apply clear finish using spray equipment.
 - 2.L.07 Demonstrate steps that are involved in wood finishing process.
 - 2.L.08 Test the resistance of paint films and related coatings.
- 2.M Properly apply spray painting.**
- 2.M.01 Prepare surface for spraying.
 - 2.M.02 Prepare material for spraying.
 - 2.M.03 Prepare equipment for spraying.
 - 2.M.04 Apply product using an airless sprayer.
 - 2.M.05 Apply product using a conventional sprayer.
 - 2.M.06 Apply product using a H.V.L.P. sprayer.
 - 2.M.07 Apply product using air airbrush.
 - 2.M.08 Apply product using an electrostatic sprayer.
 - 2.M.09 Determine pressure and flow rate for spray painting.
 - 2.M.10 Explain the function of a compressor.
 - 2.M.11 Explain the use of a reciprocating pump on a spray unit.
- 2.N Supervise, plan, and present jobs.**
- 2.N.01 Describe role of on site supervisor.
 - 2.N.02 Perform foreman's duties on a work site.
 - 2.N.03 Explain how presentation methods can help the design professional.
 - 2.N.04 Identify the materials and methods used to make a rendering.
 - 2.N.05 Describe how presentation boards, models, and slides can help a client visualize a finished project.
- 2.O Apply the fundamentals of color and design.**
- 2.O.01 Identify primary, secondary, & intermediate colors.
 - 2.O.02 Demonstrate use of the color wheel.
 - 2.O.03 Describe the various uses and effects of space, line, shape, form, texture, and color.
 - 2.O.04 Plan various color schemes using a color wheel.
 - 2.O.05 Evaluate a room design according to its scale, proportion, balance, emphasis, and rhythm.
 - 2.O.06 Plan a room design with appropriateness, harmony, variety, unity, and function.
 - 2.O.07 Evaluate the selection and placement of functional and decorative accessories according to the elements, principles, and goals of design.

- 2.O.08 Identify three ways color is used for safety.
- 2.O.09 Demonstrate the ability to use colorants for mixing.
- 2.O.10 Determine hue, value, and chroma of color.
- 2.O.11 Explain the use of a munsell color system.
- 2.O.12 Explain the process of mixing colors.
- 2.O.13 Differentiate between opaque and transparent finishes.
- 2.O.14 Determine the psychological effects of color.

2.P Apply decorative finishes.

- 2.P.01 Prepare a custom mix glaze.
- 2.P.02 Apply a marble finish.
- 2.P.03 Apply a wood grain finish.
- 2.P.04 Apply a stenciled finish.
- 2.P.05 Apply a rag/sponge finish.
- 2.P.06 Apply freehand artwork on furniture.
- 2.P.07 Demonstrate proper tool selection for special effects.

2.Q Evaluate wall coverings and textiles.

- 2.Q.01 Identify basic types of wall coverings.
- 2.Q.02 Define terms associated with wall coverings.
- 2.Q.03 Calculate the amount of wall coverings needed.
- 2.Q.04 Identify tools and equipment.
- 2.Q.05 Apply wall coverings using proper technique.
- 2.Q.06 Recognize and correct common wall covering failures.
- 2.Q.07 Describe the origins, qualities, and uses of natural and manufactured fibers.
- 2.Q.08 Evaluate a yarn in terms of the method used to create it and its advantages, disadvantages and uses.
- 2.Q.09 Describe the various types of fabric construction in terms of the methods used to produce them, their quality, and their uses.
- 2.Q.10 Evaluate the appropriateness of a fabric for a specific use within the home.

2.R Demonstrate applications of graphics and sign art.

- 2.R.01 Describe & demonstrate various methods for transferring graphics.
- 2.R.02 Demonstrate use of a stencil.
- 2.R.03 Demonstrate methods of producing lines & stripes.
- 2.R.04 Demonstrate brush control.
- 2.R.05 Select appropriate alphabets for a sign.
- 2.R.06 Demonstrate proper layout.
- 2.R.07 Select and apply shade types.
- 2.R.08 Demonstrate computer based layout & design (basic).
- 2.R.09 Apply vehicle lettering applications.
- 2.R.10 Apply vinyl lettering to various substrates.
- 2.R.11 Apply freehand artwork to signs.
- 2.R.12 Install various types of signage.

2.S Plan and design living areas.

- 2.S.01 List the rooms and activities involved in the living areas of a house.
- 2.S.02 Judge the appropriateness of a living room for a family according to its location, size, and arrangement.
- 2.S.03 Identify a dining room that meets the size and location needs of a specific family.
- 2.S.04 Recognize various types of entryways according to purpose and location.
- 2.S.05 List possible uses and styles of patios, porches, and courts.

2.T Plan and design sleeping areas.

- 2.T.01 Describe the two main types of bedroom plans.
- 2.T.02 Recognize a well-designed bedroom.
- 2.T.03 Arrange bedroom furniture in a style that is attractive and functional.
- 2.T.04 List the three main types of bathrooms and the fixtures they include.
- 2.T.05 Recognize the need for special features in the bathroom due to heat and moisture.

2.U Plan and design service areas.

- 2.U.01 Describe the three centers of the work triangle and plan an efficiently arranged kitchen using any of the six common floor plans.
- 2.U.02 Evaluate the efficiency of a laundry facility, considering its location and layout in relationship to lifestyles of the household.
- 2.U.03 List possible uses and layouts of a basement.
- 2.U.04 Determine the best location on a floor plan for a garage or carport and for service entries.

2.V Identify various features of exterior design.

- 2.V.01 Identify the distinguishing features of various styles of homes.
- 2.V.02 Identify exterior moldings and trim on various styles of residential homes.
- 2.V.03 Identify main styles of columns.
- 2.V.04 Identify common regional styles of homes.
- 2.V.05 Identify common problems to exterior paint due to landscaping.
- 2.V.06 Identify remedies to problems caused by improper landscaping.
- 2.V.07 Identify common window styles.
- 2.V.08 Identify the main purpose of a contemporary design and list its design features, advantages, and disadvantages.

2.W Summarize the early history of paint.

- 2.W.01 Discuss the historical contributions of early cultures as they relate to painting, pigmentation, and design.
- 2.W.02 Identify historical milestones in paint manufacturing.
- 2.W.03 Describe the advancements in painting and design technologies occurring in the latter part of the 20th century.
- 2.W.04 List what changes took place regarding paints during World War I and World War II.
- 2.W.05 Define when paint epoxy and urethane were produced.
- 2.W.06 Describe the importance of the Clean Air Act of 1970.

- 2.W.07 Summarize the Consumers Product Safety Commission's ban on the use of lead in all household paints.
- 2.X Summarize the history of wallcoverings and textiles.**
- 2.X.01 Discuss the historical contributions of different cultures as they relate to wallcoverings and textiles.
 - 2.X.02 Discuss changes in wallcovering from hand painted to bonding decorative paper, cloth and other materials to the wall.
 - 2.X.03 Identify when the first wallpaper-printing machine was invented and what country invented it.
 - 2.X.04 Summarize popular trends in wallcoverings.
 - 2.X.05 Identify what other products were used in wallcoverings after World War II (vinyl, plastic, etc).
 - 2.X.06 Describe the origins, qualities, and uses of natural and manufactured fibers.
- 2.Y Summarize the history of furniture.**
- 2.Y.01 List the distinguishing features of furniture from the Late Renaissance, Baroque, Regency, Rococo, Neoclassic, Directoire, and Empire periods in France.
 - 2.Y.02 Describe furniture of various styles from the Early, Middle, and Late Renaissance periods in England.
 - 2.Y.03 List the distinguishing features of the furniture of Chippendale, Hepplewhite, Sheraton, and the Adam brothers.
 - 2.Y.04 Describe the differences between Early American, American Georgian, and Federal furniture.
 - 2.Y.05 List and describe the regional styles of furniture in America.
 - 2.Y.06 List the main features of furniture in the 20th century styles.
- 2.Z Summarize the history of interior design.**
- 2.Z.01 List the distinguishing features of a Tudor style home.
 - 2.Z.02 List the distinguishing features of an early classical home.
 - 2.Z.03 List the distinguishing features of the Georgian style home.
 - 2.Z.04 List the distinguishing features of the Victorian style home.
 - 2.Z.05 List the distinguishing features of the Edwardian style home.
 - 2.Z.06 List the distinguishing features of the homes of the 1930's.
 - 2.Z.07 List the distinguishing features of recent years home styles.

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-9	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.G.1	Identify figures using properties of sides, angles, and diagonals. Identify the figures' type(s) of symmetry.	9/10	Geometry
3.B.14	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.15	10.G.5	Solve simple triangle problems using the triangle angle sum property and/or the Pythagorean theorem.	9/10	Geometry
3.B.16	10.D.1	Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plots, box-and-whisker plots, circle graph, line graph, and line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, and mode) to communicate information about the data. Use these notions to compare different sets of data.	9/10	Data Analysis, Statistics, and Probability
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.G.1	Define the sine, cosine, and tangent of an acute angle. Apply to the solution of problems.	11/12	Geometry

3.B.19	12.G.4	Relate geometric and algebraic representations of lines, simple curves, and conic sections.	11/12	Geometry
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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	1.2	Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective) using proper techniques.		Eng/Tech
3.C.30	1.3	Demonstrate the use of drafting techniques with paper and pencil or computer-aided design (CAD) systems when available.		Eng/Tech
3.C.31	1.4	Apply scale and proportion to drawings, e.g., 1/4" = 1'0".		Eng/Tech
3.C.32	1.5	Interpret plans, diagrams, and working drawings in the construction of a prototype.		Eng/Tech
3.C.33	3.2	Differentiate between specific heat and heat capacity.		Physics
3.C.34	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.35		Describe the effects of humidity, weather, and chemical substances have on painting and design materials.		Voc
3.C.36		Define the physical properties of materials used in painting and design including both surface materials and application products.		Voc
3.C.37		Explain the use of catalysts in chemical reactions relating to finishes and importance of PH levels in paint.		Voc
3.C.38		Determine absorption rates, porosity of substrates, and contamination.		Voc

3.C.39		Determine flow rate capabilities of a material.		Voc
3.C.40		Describe thermal expansion, oxidation and atomization as it applies to painting.		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.

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 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 Identify new technology for processing information.
- 6.A.14 Describe the human factors related to computers.
- 6.A.15 Develop an electronic portfolio.
- 6.A.16 Operate digital camera to record job process.

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 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.

6.D Apply painting technologies.

- 6.D.01 Demonstrate the use of computers to mix colorants.
- 6.D.02 Demonstrate the use of a spectrophotometer to match colors.
- 6.D.03 Explain the importance of electrostatic painting.
- 6.D.04 Utilize the National Painting Cost Estimator software for pricing jobs.

6.E Apply CAD design technology.

- 6.E.01 Start a sales project.
- 6.E.02 Set preferences for design.
- 6.E.03 Lay out a floor plan.
- 6.E.04 Design different rooms in a home.
- 6.E.05 Turn walls into a peninsula.
- 6.E.06 Place windows, appliances, and sinks.
- 6.E.07 Demonstrate ways to add cabinets.
- 6.E.08 Demonstrate ways to add furniture.
- 6.E.09 Perform the automatic design of cabinets.
- 6.E.10 Produce a perspective.
- 6.E.11 Revise a cabinet design.
- 6.E.12 Add countertops, molding and toe kicks.
- 6.E.13 Add color to ceilings and walls.
- 6.E.14 Add flooring materials.
- 6.E.15 Add decorative items to a room.
- 6.E.16 Create a bill of materials list.
- 6.E.17 Produce quotes and add notes.
- 6.E.18 Convert a final design to 3d imaging.
- 6.E.19 Prepare a project database.