Massachusetts Career Technical Education

Painting and Design Technologies Framework

2014

# [Strand 2: Technical Knowledge and Skills](#_bookmark0)

##### Painting and Design Safety and Health Knowledge and Skills

* + 1. Complete safety training for working on elevation equipment.
       1. Identify and describe mechanical platform lift and material handling equipment safety practices and procedures.
       2. Use and maintain fall arrest systems.
       3. Identify and describe ladder and scaffold safety practices and procedures.
    2. Performance Example:
       - Create a presentation highlighting and demonstrating safety practices, according to OSHA standards.
    3. Successfully complete lead safety training.
       1. Describe hazards and protection measures associated with lead coatings.

2.A.02 Performance Example:

* Write a research paper identifying the dangers associated with lead coatings.

##### Fundamentals of Painting and Design

* + 1. Explain concepts fundamental to Painting and Design.
       1. Describe the history of painting and design technology.
       2. List various career options within the Painting and Design field.
       3. Compare the duties and educational requirements of various occupations related to Painting and Design.
    2. Performance Examples:
       - Write a research paper identifying career opportunities, educational and credential requirements for the Painting and Design field.
       - Create a portfolio that includes a resume and a cover letter.

##### Finishes

* + 1. Explain concepts fundamental to finishes.
       1. Explain properties and function of pigments, resins, solvents & additives in paints and coatings.
       2. Identify the appropriate coating product based on a desired sheen, durability, UV resistance, and the type and condition of the substrate.
       3. Describe composition of various sealants.
       4. Compare the differences between stains and other coatings.
       5. Describe types of clear finishes.
    2. Performance Example:
       - Create a visual presentation that identifies, compares and contrasts the chemical and physical properties of various coatings.
    3. Demonstrate practices related to surface preparation.
       1. Demonstrate the use of surface preparation tools & materials.
       2. Identify surface substrates in construction.
       3. Evaluate surface conditions of substrates.
       4. Recognize and correct various coating failures.
       5. Describe and demonstrate proper use of tools and materials for protecting surfaces.
       6. Describe and demonstrate general preparations for various substrates.
       7. Identify and demonstrate the use of cleaners and strippers.
       8. Demonstrate the use of power washers.
       9. Apply caulking, fillers, and patching materials to substrates.

2.C.02.10 Demonstrate clean-up of adjacent surfaces.

2.C.02 Performance Example:

* Create sample boards that mimic the chemical and physical properties of various coating failures (i.e. blistering, peeling, chalking, efflorescence, etc.).
  + 1. Demonstrate practices related to finish applications.
       1. Identify and use tools for finish applications.
       2. Demonstrate finish application methods using brushes and rollers.
       3. Paint various architectural surfaces.
       4. Paint various door styles.
       5. Paint various window styles.
       6. Identify application considerations unique to stains.
       7. Demonstrate the selection and setup of various spray equipment and accessories for coating applications.
       8. Prepare material for various spray painting applications.
       9. Apply product using an airless sprayer.
       10. Apply product using a conventional sprayer.
       11. Apply product using a H.V.L.P. sprayer.
       12. Describe uses of an airbrush.
       13. Describe uses of an electrostatic sprayer.
       14. Demonstrate methods of clean-up and disposal of paints.
       15. Describe environmental conditions for paint application.

2.C.03 Performance Examples:

* Identify and explain the process and steps involved in painting a 6 panel door.
* Explain the atomization and viscosity of a fluid when performing spray application.

##### Drywall Finishing

* + 1. Explain concepts fundamental to drywall finishing.
       1. Identify and describe drywall finishing tools.
       2. Identify and describe materials used in drywall finishing.
    2. Performance Example:
       - Draw and label drywall tools with a description of their uses.
    3. Demonstrate practices related to drywall finishing.
       1. Repair and patch damaged drywall.
       2. Finish drywall using finishing tools.

2.D.02 Performance Example:

* Finish drywall by applying drywall tape and compound to wallboard joints, and finishing joints and screw heads according to current industry standards.

##### Fundamentals of Interior Design

* + 1. Evaluate the factors influencing housing needs and decisions.
       1. Describe the factors which affect housing choices.
       2. List the types of housing options.
       3. Evaluate client’s needs, goals, and resources in creating design plans for residential and commercial interiors and furnishings.
    2. Performance Examples:
       - Design a poster that illustrates the levels of Maslow’s Hierarchy of Needs as they relate to housing.
       - Create a problem statement and design plan to meet a customer’s needs.
    3. Demonstrate practices fundamental to Architecture and Design.
       1. Distinguish between various types and styles of housing.
       2. Identify common architectural features of a home.
       3. Identify the types of drawings included in a set of house plans and explain their purposes.
       4. Determine the utility of a floor plan in relationship to family needs.
       5. List the rooms, traffic areas and activities involved in a house.
       6. Evaluate floor plans for efficiency, safety, and functionality.
       7. Describe the various uses and effects of space, line, shape, form, texture, and color.
       8. Plan and evaluate a room design according to its scale, proportion, balance, emphasis, and rhythm.
       9. Draw an interior space to mathematically accurate scale using correct architecture symbols and drafting skills.
       10. Demonstrate space planning skills required to design a residential or commercial space using computer-aided interior design software.
       11. Create a presentation board containing a floor plan, a rendering, color schemes, textiles, and furniture samples.

2.E.02 Performance Examples:

* Create a presentation board containing a floor plan, a rendering, color schemes, textiles, and furniture samples.
* Write a research paper identifying the characteristics of architectural design styles.
* Create and present a scale model of a residential or commercial structure.
  + 1. Evaluate concepts related to selecting furnishings and accessories.
       1. Describe factors to consider in the arrangement of furniture.
       2. Identify the distinguishing features of period furniture.
       3. Create and evaluate the aesthetics and placement of decorative accessories.
       4. Describe the various types of textiles and fabrics used in housing.

2.E.03 Performance Example:

* Create a presentation showing an understanding of Universal Design and the individual needs of specific clientele.
  + 1. Demonstrate an understanding of Color Theory.
       1. Explain how light effects color.
       2. Identify primary, secondary, & intermediate colors.
       3. Demonstrate the various uses of a color wheel.
       4. Determine the hue, value, and chroma of color.
       5. Explain the use of a munsell color system.
       6. Demonstrate methods of color matching.
       7. Differentiate between opaque and transparent finishes.
       8. Describe the psychological effects of color.

2.E.04 Performance Example:

* Use a color wheel to create a color sample board demonstrating harmonious color schemes.

##### Decorative Finishes

* + 1. Explain concepts fundamental to decorative finishes.
       1. Describe the uses and applications of faux finishes.
       2. Identify tools and materials used to create faux finishing effects.
    2. Performance Example:
       - Create a decorative finish board using various faux finish techniques.
    3. Demonstrate practices fundamental to decorative finishes.
       1. Prepare a custom mix glaze.
       2. Create a polished stone faux finish.
       3. Create a wood grain faux finish.
       4. Apply a decorative pattern using a stencil.
       5. Apply wall glazing techniques using a variety of tools.

2.F.02 Performance Example:

* Create a decorative finish board using various faux finish techniques.

##### Wallcovering

* + 1. Explain concepts fundamental to wallcoverings.
       1. Identify basic types of wall coverings.
       2. Identify tools, equipment, and terminology associated with wallcoverings.
    2. Performance Examples:
       - Set up a work area with wallcoverings and the tools used to install them. Identify each tool and explain its purpose.
       - Display various types of wallcoverings and explain how they are packaged and sized, then use the symbols on the package labels to describe the products ratings; characteristics; pattern and run numbers; and pattern matches.
    3. Demonstrate practices fundamental to wallcoverings.
       1. Calculate the amount of wall coverings needed for a given area.
       2. Apply wallcoverings using proper techniques.
       3. Recognize and correct common wallcovering failures.

2.G.02 Performance Example:

* Measure a room and create a wallcovering material estimate utilizing various methods of measurement, taking into account pattern match and pattern repeat. Install wallcoverings according to current industry standards.

##### Sign Making and Mural Art

* + 1. Demonstrate practices related to sign making.
       1. Demonstrate computer based layout & design.
       2. Create a sign layout using appropriate fonts and colors selection.
       3. Apply vinyl lettering to various substrates.
       4. Install various types of signage.
    2. Performance Example:
       - Design a sign layout for a simulated or actual client.
    3. Demonstrate practices related to mural art.
       1. Describe & demonstrate various methods for transferring mural graphics.
       2. Demonstrate use of a stencil graphic.
       3. Demonstrate methods of producing lines & stripes.

2.H.02 Performance Example:

* Transfer a mural graphic onto a substrate.

##### Project Management

* + 1. Demonstrate practices related to architectural drawings and specifications.
       1. Explain the basic layout of a set of architectural drawings and the accompanying job specification documents.
       2. Identify and define basic terms, abbreviations, line types, symbols and notes.
       3. Interpret and follow drawing dimensions.
       4. Determine true drawing measurements using an Architect’s scale.
       5. Identify plan views, elevations, section and detail views and schedules.
       6. Differentiate between the types of drawings included in a set of house plans.
    2. Performance Examples:
       - Determine area of various surfaces utilizing architectural drawings.
       - Create architectural drawings which include floor plans, elevations, line types, symbols and notes for a simulated client.
    3. Demonstrate practices related to estimating.
       1. Determine quantities of materials for a job.
       2. Differentiate material, labor and overhead costs.
       3. Demonstrate the ability to price preparation cost.
       4. Create material quantity takeoff sheets.

2.I.02 Performance Examples:

* Complete job estimate for a simulated client.
  + 1. Describe management roles and responsibilities.
       1. Describe the hierarchy of an apprenticeship program.
       2. Describe role of a supervisor/foreman.
       3. Develop a detailed schedule to complete a job.

2.I.03 Performance Examples:

* Perform the duties of a job supervisor/foreman in shop or on a work extension project.

# [Strand 3: Embedded Academics](#_bookmark0)

Strand 3: Embedded Academics, a critical piece of a Vocational Technical Education Framework, are presented as Crosswalks between the Massachusetts Vocational Technical Education Frameworks and the Massachusetts Curriculum Frameworks. These Crosswalks are located in the Appendix of this Framework.

##### Academic Crosswalks

[Appendix A: English Language Arts](#_bookmark20) [Appendix B: Mathematics](#_bookmark20)

[Appendix C: Science and Technology/Engineering](#_bookmark22) Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics) Technology/Engineering

# [Embedded Academic Crosswalks](#_bookmark0)

### Embedded English Language Arts and Literacy

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| CVTE  Learning Standard Number | Strand Coding Designation Grades ELAs  Learning Standard Number | Text of English Language Arts Learning Standard |
| 2.A, 2.B, | SL Grades 9-12 #1 (a-d) | Initiate and participate effectively in a range of collaborative |
| 2.C, 2.D, |  | discussions (one-on-one, in groups, and teacher led) with diverse |
| 2.E, 2.F, |  | partners on grades 9-12 topics, texts, and issues, building on other’s |
| 2.G, 2.H, 2.I |  | ideas and expressing their own clearly and persuasively. |
|  |  | a. Come to discussions prepared having read and researched |
|  |  | material under study; explicitly draw on that preparation by |
|  |  | referring to evidence from texts and other research on the topic or |
|  |  | issue to stimulate a thoughtful, well-reasoned exchange of ideas. |
|  |  | b. Work with peers to set rules for collegial discussions and decision- |
|  |  | making (e.g., informal consensus, taking votes on key issues, and |
|  |  | presentation of alternate views), clear goals and deadlines, and |
|  |  | individual roles as needed. |
|  |  | c. Propel conversations by posing and responding to questions that |
|  |  | relate the current discussion to broader themes or larger ideas; |
|  |  | actively incorporate others into the discussion; and clarify, verify, or |
|  |  | challenge ideas and conclusions. |
|  |  | d. Respond thoughtfully to diverse perspectives, summarize points of |
|  |  | agreement and disagreement, and, when warranted, qualify or justify |
|  |  | their own views and understanding and make new connections in |
|  |  | light of the evidence and reasoning presented.  Performance Example:  Students participate in various types of discussion on a daily basis, discussing topics as a class, collaborating on projects, and evaluating results with teachers and other students. |
| 2.A, 2.B, | SL Grades 9-12 #4 | Present information, findings, and supporting evidence, conveying a |
| 2.C, 2.D, |  | clear and distinct perspective, such that listeners can follow the line |
| 2.E, 2.F, |  | of reasoning, alternative or opposing perspectives are addressed, |
| 2.G, 2.H, 2.I |  | and the organization, development, substance, and style are |
|  |  | appropriate to purpose, audience, and a range of formal and informal |
| 2.A, 2.B, | SL Grades 9-12 #5 | Make strategic use of digital media (e.g., textual, graphical, audio, |
| 2.C, 2.E, |  | visual, and interactive elements) in presentations to enhance |
| 2.H, 2.I |  | understanding of findings, reasoning, and evidence and to add interest.  Performance Example:   * Students present an original presentation board that includes a floor plan, a rendering, color schemes, textiles, and furniture samples, explaining their choices for each. Students should use a variety of digital   media to create their board and/ or presentation. |
| 2.A, 2.B, | L Grades 6-8 #2 (a.c) | Demonstrate command of the conventions of standard English |
| 2.C, 2.D, |  | capitalization, punctuation, and spelling when writing. |
| 2.E, 2.F,  2.G, 2.H, 2.I |  | a. Use punctuation (comma, ellipsis, dash) to indicate a pause or break. |
|  |  | c. Spell correctly.  Performance Example:  When writing or presenting reports, writing papers, or creating finished products, students will use standard English in order to demonstrate professionalism. |
| 2.A, 2.B, | L Grades 9-12, #4 (a.d) | Determine or clarify the meaning of unknown and multiple-meaning |
| 2.C, 2.D, |  | words and phrases based on grades 11–12 reading and content, |
| 2.E, 2.F, |  | choosing flexibly from a range of strategies. |
| 2.G, 2.H, 2.I |  | a. Use context (e.g., the overall meaning of a sentence, paragraph, or |
|  |  | text; a word’s position or function in a sentence) as a clue to the |
|  |  | meaning of a word or phrase. |
|  |  | d. Verify the preliminary determination of the meaning of a word or |
|  |  | phrase (e.g., by checking the inferred meaning in context or in a |
|  |  | dictionary).  Performance Example:  Students define technical terms and unfamiliar vocabulary from textbook and other texts, using both context clues and appropriate reference materials. |
| 2.A, 2.B,  2.C, 2.E,  2.F, 2.H, 2.I | RST Grades pre and Grades 9- 12 #1 | (pre) Cite specific textual evidence to support analysis of science and technical texts.  (9-10)Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. |
|  |  | (11-12)Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.  Performance Example:   * Students will cite textbook or other materials to support their reasoning in discussion and in writing when appropriate. For example, students write a short report describing the proper environmental conditions for   paint application, using evidence from either the textbook or another resource. |
| 2.A, 2.B,  2.C, 2.D, | RST Grades 11-12 #2 | Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by |
| 2.E, 2.F, |  | paraphrasing them in simpler but still accurate terms.  Performance Example:  After reading about faux finishes, the student creates a polished stone faux finish and then summarizes the process. |
| 2.G, 2.H, 2.I |  |  |
| 2.C, 2.D, | RST Grades 9-12 #3 | Follow precisely a complex multistep procedure when carrying out |
| 2.E, 2.F, |  | experiments, taking measurements, or performing technical tasks; |
| 2.G, 2.H, 2.I |  | analyze the specific results based on explanations in the text.  Performance Example:  Student uses an established recipe as a guide to create a faux finish effect. After completing the project, they write a process paper explaining the steps they used to get their specific results. |
| 2.A, 2.B, | RST Grades 9-12 #4 | Determine the meaning of symbols, key terms, and other domain- |
| 2.C, 2.D, |  | specific words and phrases as they are used in a specific scientific or |
| 2.E, 2.F, |  | technical context relevant to grades 9-10 and 11–12 texts and topics.  Performance Example:  When examining architectural drawings, students recognize and identify basic terms, abbreviations, line types, symbols, and notes. |
| 2.E.04 | RST Grades 9-10 #5 | Analyze the structure of the relationships among concepts in a text, including relationships among key terms.  Performance Example:  Students learning about color theory can explain how light affects color and how the three dimensions of color (hue, value, and chroma) determine color variation. |
| 2.C, 2.E,  2.H, 2. I | RST Grades 9-10 #7 | Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate |
|  |  | information expressed visually or mathematically (e.g., in an |
|  |  | equation) into words.  Performance Example:  Students interpret and follow drawing dimensions. Students use plans to determine quantities of materials needed for a given job and describe those materials, the labor and overhead costs. |
| 2.A, 2.E,  2.I | RST Grades 11-12 #7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, |
|  |  | multimedia) in order to address a question or solve a problem.  Performance Example:  Given a design problem, students use multiple sources of information to create a presentation showing an understanding of Universal Design and the individual needs of specific clientele. |
| 2.A, 2.B, | RST Grades 9-12 #10 | By the end of grade (9, 10, 11, 12), read and comprehend |
| 2.C, 2.D, |  | science/technical texts in the grades 9–CCR text complexity band |
| 2.E, 2.F, |  | independently and proficiently.  Performance Example:  Students read various levels of text (textbook, articles, journals), including the adopted textbook. |
| 2.G, 2.H, 2.I |  |  |
| 2.A, 2.B, | WHST Grades 9-10 | Write informative/explanatory texts, including the narration of |
| 2.C, 2.D, | #2 (a-f) | historical events, scientific procedures/ experiments, or technical |
| 2.E, 2.F, |  | processes. |
| 2.G, 2.H, 2.I |  | a. Introduce a topic and organize ideas, concepts, and information to |
|  |  | make important connections and distinctions; include formatting |
|  |  | (e.g., headings), graphics (e.g., figures, tables), and multimedia when |
|  |  | useful to aiding comprehension. |
|  |  | b. Develop the topic with well-chosen, relevant, and sufficient facts, |
|  |  | extended definitions, concrete details, quotations, or other |
|  |  | information and examples appropriate to the audience’s knowledge |
|  |  | of the topic. |
|  |  | c. Use varied transitions and sentence structures to link the major |
|  |  | sections of the text, create cohesion, and clarify the relationships |
|  |  | among ideas and concepts. |
|  |  | d. Use precise language and domain-specific vocabulary to manage |
|  |  | the complexity of the topic and convey a style appropriate to the |
|  |  | discipline and context as well as to the expertise of likely readers. |
|  |  | e. Establish and maintain a formal style and objective tone while |
|  |  | attending to the norms and conventions of the discipline in which |
|  |  | they are writing. |
|  |  | f. Provide a concluding statement or section that follows from and |
|  |  | supports the information or explanation presented (e.g., articulating |
|  |  | implications or the significance of the topic).  Performance Example: Students write process, compare-contrast, and other expository papers/ reports when appropriate. For example, students write a short essay comparing two occupations related to Painting and Design. |
| 2.A, 2.B, | WHST Grades 9-12 #4 | Produce clear and coherent writing in which the development, |
| 2.C, 2.D, |  | organization, and style are appropriate to task, purpose, and |
| 2.E, 2.F,  2.G, 2.H, 2.I |  | audience.  Performance Example:  Students read an article or a chapter from the textbook and write a summary. |
| 2.A, 2.B, | WHST Grades 9-12 #5 | Develop and strengthen writing as needed by planning, revising, |
| 2.C, 2.D, |  | editing, rewriting, or trying a new approach, focusing on addressing |
| 2.E, 2.F, |  | what is most significant for a specific purpose and audience  Performance Example:  For their portfolio, students must revise goals and ambitions papers, cover letters and resumes. |
| 2.G, 2.H, 2.I |  |  |
| 2.A, 2.B,  2.C, 2.E, | WHST Grades 9-12 #7 | Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; |
| 2.F, 2.G, |  | narrow or broaden the inquiry when appropriate; synthesize |
| 2.H, 2.I |  | multiple sources on the subject, demonstrating understanding of the subject under investigation.  Performance Example:  Students write research papers identifying the characteristics of architectural design styles. |
| 2.A, 2.B, | WHST Grades 9-12 #9 | Draw evidence from informational texts to support analysis, |
| 2.C, 2.E, |  | reflection, and research. |
| 2.F, 2.G, |  | Performance Example:   * Students read text and write about their findings, citing information from research. For example, students cite text when given the question, “How does color affect people psychologically?” students conduct research and write a short report about the effects and uses of one color, including specific examples found   while researching. |
| 2.H, 2.I |  |  |
| 2.A, 2.B,  2.C, 2.D, | WHST Grades 9-12 #10 | Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) |
| 2.E, 2.F, |  | for a range of discipline-specific tasks, purposes, and audiences.  Performance Example:  Students will write formally (process papers), informally (journals and logs), and for short periods (exams) as well as revising and using extended periods for projects. |
| 2.G, 2.H, 2.I |  |  |

### [Embedded Mathematics](#_bookmark0)

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| CVTE  Learning Standard Number | Math Content Conceptual Category and Domain Code Learning Standard Number | Text of Mathematics Learning Standard |
| 2.E, 2.H,  2.I | **7.G .1** | Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.  Performance Example:  Create a mural graphic from a scaled drawing. |
| 2.E.02 | 7.G.2 | Draw (freehand, with ruler and protractor, and with technology)  geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the |
|  |  | conditions determine a unique triangle, more than one triangle, or no triangle.  Performance Example:  Create and present a scale model of a residential or commercial structure. |
| 2.I.02 | 8.EE.7 | Solve linear equations in one variable.  Performance Example:  Solving for quantities of materials, labor, and overhead costs. |
| 2.H.01 | 8.NS.1 | Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that  terminate in 0s or eventually repeat. Know that other numbers are called irrational.  Performance Example:  Round measurements up to the nearest decimal place when determine layouts for various types of signage. |
| 2.E.02 | G.GMD.4 | Identify the shapes of two-dimensional cross-sections of three- dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.  Performance Example:  Create a presentation board containing a floor plan, a rendering, color schemes, textiles, and furniture samples. |
| 2.I.01  2.G.01 | G.GPE.7 | Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.  Performance Example:  Determine area of various surfaces utilizing architectural drawings. |
| 2.E.03 | G.MG.1 | Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).  Performance Example:  Create a presentation showing an understanding of Universal Design and the individual needs of specific clientele. |
| 2.G.02 | G.MG.4 | Use dimensional analysis for unit conversion to confirm that expressions and equations make sense.  Performance Example:  Convert metric system to standard English equivalent units while calculating wallpaper coverage. |
| 2.E, 2.G,  2.H, 2.I | G.CO.1 | Know precise definitions of angle, circle, perpendicular line, parallel  line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.  Performance Example:  Understand the definition of shapes and mathematical terms as they relate to various substrates. |
| 2.E.02 | G.CO.12 | Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular  bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.  Performance Example:  Create drawings, renderings and scale models of residential and commercial structures. |
| 2.H.02 | 8.G.7 | Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real world and mathematical problems in two  and three dimensions.  Performance Example:  Use Pythagorean Theorem to calculate sizes when scaling graphics. |
| 2.I.02 | S.ID.1, S.ID.2 | Represent data with plots on the real number line (dot plots, |
|  |  | histograms, and box plots).  Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.  Performance Example:  Calculate average amount of time needed to price preparation of material and costs of a job. |
| 2.E.02 | G.SRT.6 | Define trigonometric ratios and solve problems involving right triangles. Understand that by similarity, side ratios in right triangles  are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.  Performance Example:  Use trigonometric ratios to find angles and missing sides of right triangles when creating or drawing a floor plan. |
| 2.E.04 | F.IF.4 | For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the*  *function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*  Performance Example:  Use formula guides and charts to determine the quantities of pigments needed when color mixing. |
| 2.E, 2.F,  2.G, 2H | G.MG.3 | Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize  cost; working with typographic grid systems based on ratios).  Performance Example:  Design a geometric pattern for use on a decorative faux finish panel. |
| 2.H.01 | N.Q.1 | Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and  data displays.  Performance Example:  Create scaled layouts for a customer’s sign design. |
| 2.I.03 | N.Q.2 | Define appropriate quantities for the purpose of descriptive modeling.  Performance Example:  Develop a detail schedule to complete a job using unit cost estimating and material quality take-offs. |
| 2.I.02 | N.Q.3a | Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. Identify significant figures in recorded measures and  computed values based on the context given and the precision of the tools used to measure.  Performance Example:  Identify estimate errors when overhead costs are not accounted for. |
| 2.E.01 | A.CED.4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  Performance Example:  Calculate mortgage costs when evaluating factors that influence housing needs and decisions. |

### [Embedded Science and Technology/Engineering](#_bookmark0)

#### Earth and Space Science

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Earth and Space Science Learning Standard |
| 2.E.04 | 1.Matter and Energy in the Earth System 1.2 | Describe the characteristics of electromagnetic radiation and give examples of its impact on life and Earth’s systems.  Performance Example:  Describe how light affects color and that light is part of the visible spectrum of electromagnetic waves which includes heat, radio waves, and microwaves. |

#### [Physical Science (Chemistry)](#_bookmark0)

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Chemistry Learning Standard |
| 2.C.01 | 1.Properties of Matter 1.1 | Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties  (e.g., the ability to form new substances). Distinguish between chemical and physical changes.  Performance Example:  Explain the physical and chemical properties of resins and how they interact with pigments and solvents. |
| 2.C | 1.Properties of Matter 1.2 | Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous  and homogeneous mixtures.  Performance Example:  Students explain coalescence and the curing of coatings. |
| 2.C.03 | 4.Chemical Bonding 4.3 | Use electronegativity to explain the difference between polar and nonpolar covalent bonds.  Performance Example:  Explain the unique properties of an electrostatic sprayer and the process of spray applications. |
| 2.F.02, 2.G | 7.Solutions, Rates of Reac- tions, and Equilibrium 7.1 | Describe the process by which solutes dissolve in solvents.  Performance Example:  Describe the process used to mix wall covering adhesive. |
| 2.C.02 | 7.Solutions, Rates of Reactions, and Equilibrium  7.5 | Identify factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area,  catalyst)  Performance Example:  Explain factors that affect coatings during finish applications. |
| 2.C.02 | 8.Acids and Bases and Oxidation-Reduction Reactions 8.2 | Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap,  citrus juice).  Performance Example:  Students will neutralize the acid properties of a stripper prior to applying a coating or stain. |
| 2.C.02 | 8.Acids and Bases and Oxidation-Reduction Reactions 8.4 | Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.  Performance Example:  Create sample boards that mimic the chemical and physical properties of various coating failures (i.e. blistering, peeling, oxidation, efflorescence, etc. |
| 2.G.02 | SIS1.Make observations, raise questions and formulate hypothesis | Observe the world from a scientific perspective.  Read, interpret, and examine the credibility and validity of scientific  claims in different sources of information, such as scientific articles, advertisements, or media stories.  Performance Example:  Students will research various publications with information about wallcovering failures to determine the causes. |
| 2.E.03 | SIS3 Analyze and interpret results of scientific  investigations | Represent data and relationships between and among variables in charts and graphs.  Use appropriate technology (e.g., graphing software) and other tools.  Performance Example:  Create a presentation showing an understanding of Universal Design and the individual needs of specific clientele. |
| 2.I.01,  2.E.02 | SIS4 Communicate and apply the results of scientific investigations | Develop descriptions of and explanations for scientific concepts that were a focus of one or more investigations  Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology (e.g., presentation software) and other tools to present findings.  Performance Example:  Create architectural drawings which include floor plans, elevations, line types, symbols and notes for a simulated client. |

#### [Physical Science (Physics)](#_bookmark0)

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Physics Learning Standard |
| 2.E.04 | 4.Waves4.1 | Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, and period).  Performance Example:  Students will be able to identify various wavelengths in the visible spectrum. |
| 2.E.04 | 4.Waves4.2 | Distinguish between mechanical and electromagnetic waves.  Performance Example:  Students will be able to compare and contrast sound and light waves. |
| 2.C.01,  2.E.04 | 4.Waves4.4 | Describe qualitatively the basic principles of reflection and refraction of waves.  Performance Example:  Students will be able describe reflection and refraction in relating it to degrees of gloss in a paint sheen. |
| 2.E.04 | 6.Electromagnetic Radiation6.2 | Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green, blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the  spectrum.  Performance Example:  Students will be able to identify and describe the electromagnetic spectrum and identify where visible light falls on the spectrum. |

#### [Technology/Engineering](#_bookmark0)

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| CVTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Technology/Engineering Learning Standard |
| 2.E.02 | 1.Materials, Tools, and Machines 1.3 | Identify and explain the safe and proper use of measuring tools, hand tools, and machines (e.g. band saw, drill press, sander, hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) needed to construct a prototype of an  engineering design.  Performance Example:  Students will use measuring tools and hand tools to build a model of a building from a design that they created. |
| 2.E, 2.H | 2.Engineering Design 2.1 | Identify and explain the steps of the engineering design process, ie, identify the need or 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  Performance Example:  Students will research and build a model of a building from a design that they created. |
| 2.E.02, 2.H | 2.Engineering Design 2.2 | Demonstrate methods of representing solutions to a design problem, e.g., sketches, orthographic projections, multi view drawings.  Performance Example:  Create a presentation board containing a floor plan, a rendering, color schemes, textiles, and furniture samples. |
| 2.E.02 | 2.Engineering Design 2.3 | Describe and explain the purpose of a given prototype.  Performance Example:  Create and present a scale model of a residential or commercial structure. |
| 2.E.02 | 2.Engineering Design 2.4 | Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.  Performance Example:  Students will construct a scale model of a residential or commercial structure from an architectural print. |
| 2.E.01 | 2.Engineering Design 2.5 | Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.  Performance Example:  Create a design plan and concept boards to meet a customer’s needs. |
| 2.I.01 | 3.Communication Technologies 3.2 | Identify and explain the appropriate tools, machines, and electronic devices (e.g. drawing tools, computer-aided design, and cameras) used to produce and/or reproduce design solutions (e.g. Engineering  drawings, prototypes, and reports.  Performance Example:  Create architectural drawings which include floor plans, elevations, line types, symbols and notes for a simulated client using drawing tools and computer-aided design software. |
| 2.I.01 | 3. Communication  Technologies 3.4. | Identify and explain how symbols and icons (e.g. international symbols and graphics) are used to communicate a message.  Performance Example:  Locate line types, symbols, and notes from a set of architectural drawings, and explain their meaning. |
| 2.E.02 | 1.Engineering Design 1.1 | Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution (s), construct prototypes |
|  |  | and/or models, test and evaluate, communicate the solutions, and redesign.  Performance Example:  Students will research a client’s design problem statement and develop concept boards, drawings, and models to solve the client’s design needs. |
| 2.C.01 | 1.Engineering Design 1.2 | Understand that the engineering design process is used in the solutions of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were  modified.  Performance Example:  Students identify a product or material to be used in a design project. Then, they will conduct research to find a comparable product that is more eco-friendly. |
| 2.E.02.11 | 1.Engineering Design 1.3 | Produce and analyze multi-view drawings (orthographic  projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.  Performance Example:  Create a presentation board containing a floor plan, a rendering, color schemes, textiles, and furniture samples. |
| 2.H | 1.Engineering Design 1.4 | Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g. 1/4'’=1’0’’, 1 cm=1m).  Performance Example:  Students will to create a sign from a scaled layout. |
| 2.I.01 | 1.Engineering Design 1.5 | Interpret plans, diagrams, and working drawings in the construction of prototypes or models.  Performance Example:  Determine area of various surfaces utilizing architectural drawings. |
| 2.A, 2.C,  2.D, 2.E,  2.F, 2.G,  2.H | 2.Construction Technologies 2.5 | Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.  Performance Example:  Complete written and performance exams that demonstrate the safe and proper use of shop tools |
| 2.1.01 | 2.Construction Technologies  2.6 | Recognize the purposes of zoning laws and building codes in the design and use of structure.  Performance Example:  Students will investigate local building codes for simulated project. |
| 2.E.01 | 4.Energy and Power Technologies-Thermal Systems 4.3 | Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.  Performance Example:  Students will be able to describe how environmental factors influence the design and construction of houses. |
| 2.C | 7.Manufacturing Technologies 7.2 | Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).  Performance Example:  Students will take a field trip to a paint manufacturing facility and write a paper describing the processes used to create the paints and coatings. |

[Industry Recognized Credentials](#_bookmark0) (Licenses and Certifications/Specialty Programs)

OSHA 10 Hour Outreach Training Program