Massachusetts Career Technical Education

Drafting Framework

2014

DESE is in the process of updating all CTE Frameworks. This framework was adopted in 2014. More information about the process to update frameworks will be provided in DESE’s CCTE Newsletter.

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

###### Drafting Safety Knowledge and Skills

* + 1. Demonstrate an understanding of the importance of wearing safety glasses in setting where hazards are present and on outside job sites.
    2. Identify and apply good ergonomic practices as they apply to the work of Drafters, both in shop settings and on outside projects.

###### Fundamental of Drafting and Design

* + 1. Apply general drafting standards.
       1. Identify drawing media and related drafting materials.
       2. Annotate a drawing by using basic systems of measurement.
       3. Convert between English and metric systems (ISO) of measurement.
       4. Identify the alphabet of lines.
       5. Prepare title blocks and other drafting formats.
       6. Catalog and use number system for documentation and file management.
       7. Demonstrate methods used to record revisions.
       8. Produce prints, plots and reproductions to appropriate scale.
    2. Performance Example:
       - Create a drawing using appropriate format and size. Include proper linetypes, revision, notes, etc. Produce a print to appropriate scale.
    3. Develop views.
       1. Create orthographic views.
       2. Create auxiliary views.
       3. Create section views.
       4. Create detail views.
       5. Create isometric views.
       6. Place views considering first and third angle projection.
       7. Identify 1, 2, and 3 point perspectives.

2.B.02 Performance Example:

* Given an object, develop a drawing that requires the use of each of the views listed.
  + 1. Apply the design process.
       1. Evaluate a problem and develop a solution using the design process.
       2. Interpret detail prints or technical processes.
       3. Identify key elements that impact design.

2.B.03 Performance Example:

* Given a product, apply the design process to develop new or revised product. Include documentation for each step of process.

###### Conventional Drafting Techniques and Skills

* + 1. Create free-hand technical sketches.
       1. Letter using block style.
       2. Sketch basic concept and/or object proportionately.
       3. Make a sketch including detailed measurements/annotations.
       4. Sketch a basic object based on “customer” needs.
    2. Performance Example:
       - Given an object, sketch appropriate views in proportion with annotations.
    3. Apply dimensioning.
       1. Apply correct dimension line terminators.
       2. Apply size and location dimension practices.
       3. Apply the use of dimensioning types (ordinate, leader, baseline/datum, chain, tabular).
       4. Identify appropriate standard symbols.
       5. Apply aligned and unidirectional methods.
       6. Apply general notes and/or annotations to a drawing.

2.C.02 Performance Example:

* Using an existing drawing, apply appropriate dimensioning standards.
  + 1. Measure, using the tools, knowledge and skills essential to drafting professionals.
       1. Identify different measurement tools and their applications.
       2. Measure parts using engineering, architectural, civil engineering, fractional, metric, and decimal inch scales.
       3. Measure parts using vernier caliper and micrometer.
       4. Develop drawings utilizing measurements.

2.C.03 Performance Example:

* Create an as-built drawing based on actual measurements taken.

###### Computer Aided Drafting and Design

* + 1. Create CAD template.
       1. Set up layers/levels.
       2. Set up dimension types (units/precision/scale/style/etc.).
    2. Performance Example:
       - Set parameters for a new drawing based on project requirements.
    3. Produce CAD drawing.
       1. Edit CAD drawing.
       2. Manipulate CAD drawing.
       3. Extract CAD data (mass/volume/area/etc.).
       4. Create 3D models.
       5. Create translatable files (pdf, dxf, stl, iges, step, etc.).

2.D.02 Performance Example:

* Modify or create model based on requirements, record CAD data and create output file.

###### Mechanical Drafting and Design

* + 1. Develop sheet metal patterns.
       1. Identify sheet metal terminology and gauges.
       2. Develop basic shapes using radial line and parallel line development.
       3. Develop a flat pattern for precision bending.
    2. Performance Example:
       - Using a discarded product such as a milk carton or shoe box, create a full size pattern drawing.
    3. Detail and Dimension Weldment.
       1. Identify welding processes.
       2. Identify various types of welded joints.
       3. Apply welding symbols to a drawing.

2.E.02 Performance Example:

* Convert a cast part to a weldment using various symbols and processes.
  + 1. Identify manufacturing processes.
       1. Identify casting, forging, molding, extruding, machining, metal fabrication, and welding, etc. procedures.

2.E.03 Performance Example:

* Students create a presentation and assessment questions on one or more processes.
  + 1. Produce mechanical drawings.
       1. Draw detail drawings.
       2. Draw assembly drawings.
       3. Draw layout drawings.
       4. Incorporate appropriate specification details using resources (standard/purchased items, machinery’s handbooks, ASTM and ANSI standards, etc.).
       5. Apply dual dimensioning for product and/or manufacturing drafting needs.

2.E.04 Performance Example:

* Create a layout, detail and assembly drawing for a simple product (pen, depth gauge, etc.)
  + 1. Apply tolerances.
       1. Identify tolerancing terminology.
       2. Dimension with a consideration for tolerance stack-ups.
       3. Calculate clearance and interference fit tolerance of mating parts using tables (RC, LN, FN, LT, LC).
       4. Apply tolerance to dimensions using unilateral, bilateral and limits.
       5. Apply geometric tolerance symbols.
       6. Determine location of datum symbols.
       7. Identify and apply surface (finish) control to part surfaces.

2.E.05 Performance Example:

* Create detail and assembly drawing with consideration of mating part fit.
  + 1. Differentiate mechanical components.
       1. Identify breaks, joints, couplings, bearings, clutches, belts, chains, gears, cams, etc.
       2. Identify different types of fasteners (e.g., screws, nuts, rivets, springs, keys, pins, washers, etc.).
       3. Specify thread nomenclature, series, classifications, and fits and forms.

2.E.06 Performance Example:

* Students create a presentation and assessment questions on one or more components.
  + 1. Identify electro-mechanical drawings.
       1. Identify basic electric/electronic components and symbols used in drafting.
       2. Identify a schematic, wiring diagram, circuit diagram, and cable/harness drawings.

2.E.07 Performance Example:

* Interpret an existing diagram identifying appropriate symbols.

###### Architectural Drafting and Design

* + 1. Identify building types.
       1. Distinguish between commercial, residential, and industrial construction.
       2. Recognize the architectural styles of buildings.
    2. Performance Example:
       - Students create a presentation and assessment questions on building types and styles.
    3. Draw construction drawings.
       1. Select appropriate references (building codes, ADA, Architectural Graphic Standards, etc.).
       2. Draw a plot plan considering civil engineering principles.
       3. Draw floor plans (considering appropriate room planning: service, sleeping, and living areas).
       4. Draw foundation plan (footings, etc.).
       5. Draw interior/exterior elevations.
       6. Draw sections.
       7. Draw details (framing, window, door, etc.).
       8. Draw roof plan.
       9. Incorporate door, window and finish schedules.
       10. Interpret electrical, plumbing, fireplace, exhaust, and HVAC drawings.
       11. Calculate, develop, and layout stairs.
       12. Create a set of the above drawings listed as they apply to one building / residence.
       13. List common construction material sizes/lengths and describe how these constraints should be considered in design.

2.F.02 Performance Example:

* Produce plans for a simple single-story residence.

###### Sustainability

* + 1. Recognize Green Design.
       1. Identify product design requirements.
       2. Identify architectural design requirements (e.g., (LEED) Leadership in Energy and Environmental Design).

Third Year Drafting

Listed below are additional Categories of Learning, Standards and Objectives beyond the scope of the two year DESE requirement. They are placed in Supplemental Activities and can be used in the third year of a Drafting and Design Technology program.

**2.H\* ARCHITECTURAL DRAFTING AND DESIGN – *Supplemental Activities***

2.H.01\* Calculate dead, live, snow and wind loads on the designed residential house.

* + - 1. \* Determine the tributary area of structural elements on the designed residential house.
      2. \* Trace loads through the building to the foundation.

2.H.02\* Redesign a parking lot.

* + - 1. \* Survey an existing parking lot.
      2. \* Redesign the parking lot for maximum usage. 2.H.02.03\* Estimate the cost of the redesign of the parking lot.

2.H.03\* Determine the heat loss of the designed residential house.

2.H.04\* Identify elements of civil design.

2.H.04.01\* Describe materials and properties used in civil design. 2.H.04.02\* Identify common civil symbols.

* + - 1. \* Identify zoning, environmental, and other regulations and guidelines that impact development.
      2. \* Identify surveying instruments.
      3. \* Plot using bearings, distances, and coordinates.
      4. \* Place utilities, accesses, and contours within size and specifications as described in code.
      5. \* Determine acreage.

**2.I\* COMPUTER AIDED DRAFTING AND DESIGN – *Supplemental Activities***

2.I.01\* Set up CAD drawing format

# [Embedded Academic Crosswalks](#_bookmark0)

### [Embedded English Language Arts and Literacy](#_bookmark0)

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| --- | --- | --- |
| CTE  Learning Standard Number | Strand Coding Designation Grades ELAs  Learning Standard Number | Text of English Language Arts Learning Standard |
| 2.B, 2.C,  2.D, 2.E,  2.F | SL Grades 9-12 #1 (a-d) | Initiate and participate effectively in a range of collaborative  discussions (one-on-one, in groups, and teacher led) with diverse partners on grades 9-12 topics, texts, and issues, building on other’s 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.03,  2.A.02,  2.D.04 | SL Grades 9-12 #4 | Present information, findings, and supporting evidence, conveying a  clear and distinct perspective, such that listeners can follow the line  of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are  appropriate to purpose, audience, and a range of formal and informal  tasks.  Performance Example:  Students present the plans they created for a simple single-story residence; explaining why they made specific choices in style and materials. |
| 2.D.04 | SL Grades 9-12 #5 | Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add  interest.  Performance Example:  Students will use multimedia tools and media from computer/ internet to incorporate appropriate specification details for detailed mechanical drawings. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | L Grades 6-8 #2 (a, c) | Demonstrate command of the conventions of standard English  capitalization, punctuation, and spelling when writing.  a. Use punctuation (comma, ellipsis, dash) to indicate a pause or  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,  2.C, 2.D,  2.E, 2.F | L Grades 9-12, #4 (a,d) | Determine or clarify the meaning of unknown and multiple-meaning  words and phrases based on grades 11–12 reading and content,  choosing flexibly from a range of strategies.  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 materials, using both context and appropriate reference materials. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | 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, when discussing manufacturing processes, the student will refer to specific texts   as evidence to support an opinion on which is the most cost effective way to complete a task. |
| 2.D.04,  2.B.01,  2.E.2.F | 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  paraphrasing them in simpler but still accurate terms.  Performance Example:  Students Given a document that specifies “customer” needs, students will determine the central ideas and create set of appropriate drawings. |
| 2.A.01,  2.B.01,  2.D.03 | RST Grades 9-12 #3 | Follow precisely a complex multistep procedure when carrying out  experiments, taking measurements, or performing technical tasks;  analyze the specific results based on explanations in the text.  Performance Example:  Students follow multiple steps to complete designs or drawings and then analyze their results, comparing them to models. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | RST Grades 9-12 #4 | Determine the meaning of symbols, key terms, and other domain-  specific words and phrases as they are used in a specific scientific or  technical context relevant to grades 9-10 and 11–12 texts and topics.  Performance Example:  Students define technical terms and vocabulary from textbook and other sources, using both context and appropriate reference materials. |
| 2.D.06 | RST Grades 9-10 #5 | Analyze the structure of the relationships among concepts in a text, including relationships among key terms.  Performance Example:  Students design and/or use a combination of simple machines, analyzing the relationships between concepts involved (such force, friction, weight and other variables) |
| 2.A.02 | 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:  Architecture: Given a set of building parameters, students will design a structure to meet the requirements (will translate text to a visual product, i.e. plans). |
| 2.A.03 | 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:   * Students will use available sources such as textbook, technical manuals, and internet media to solve a problem. For example, students redesign a cell phone case according to certain parameters and specifications. |
| 2.F.02 | RST Grades 9-10 #9 | Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the  findings support or contradict previous explanations or accounts.  Performance Example:  Students will compare and contrast information presented about Green Energy/ Design, evaluating the best/ most appropriate use of these technologies in a given design. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | RST Grades 9-12 #10 | By the end of grade (9,10, 11,12), read and comprehend  science/technical texts in the grades 9–CCR text complexity band independently and proficiently.  Performance Example:  Students read various levels of text (textbook, articles, journals), including the adopted textbook. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | WHST Grades 9-10  #2 (a-f) | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.  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 might explain a design process (2.A.03), describe one of the manufacturing processes (2.D.03), or describe and compare architectural styles of buildings (2.E.01) |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | WHST Grades 9-12 #4 | Produce clear and coherent writing in which the development,  organization, and style are appropriate to task, purpose, and  audience.  Performance Example:  Students read an article or a chapter from the textbook and write a summary. |
| 2.B.01 | WHST Grades 9-12 #5 | Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing  what is most significant for a specific purpose and audience  Performance Example:  Notes and annotations on finished designs and drawings must be precise and concise. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | 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;  narrow or broaden the inquiry when appropriate; synthesize  multiple sources on the subject, demonstrating understanding of the  subject under investigation.  Performance Example:  After designing and completing scaled drawings for a small cottage (800-1000 square feet) with kitchen, bath, eating and sleeping areas, students build a scaled model from foamboard. |
| 2.A, 2.B,  2.C, 2.D, 2.E, 2.F | WHST Grades 9-12 #9 | Draw evidence from informational texts to support analysis, reflection, and research.  Performance Example:   * Students read text and write about their findings, citing information from research. For example, students   cite text when discussing or defending manufacturing processes. As a reflective activity, Students cite text when evaluating their complete drawings. |
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| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | 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)  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.B, 2.C,  2.D, 2.E,  2.F | SL Grades 9-10 #1 (a-d) | Initiate and participate effectively in a range of collaborative  discussions (one-on-one, in groups, and teacher led) with diverse  partners on grades 9-10 topics, texts, and issues, building on other’s  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. |
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| 2.B.03,  2.B.02,  2.E.04 | SL Grades 9-12 #4 | Present information, findings, and supporting evidence, conveying a  clear and distinct perspective, such that listeners can follow the line  of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are  appropriate to purpose, audience, and a range of formal and informal  tasks.  Performance Example:  Students present the plans they created for a simple single-story residence; explaining why they made specific choices in style and materials. |
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| 2.E.04,  2.B.01,  2.F, 2G | 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  paraphrasing them in simpler but still accurate terms.  Performance Example:  Given a document that specifies “customer” needs, students will determine the central ideas and create set of appropriate drawings. |
| 2.B.01,  2.C.01,  2.E.03 | RST Grades 9-12 #3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks;  analyze the specific results based on explanations in the text.  Performance Example:  Students follow multiple steps to complete designs or drawings and then analyze their results, comparing them to models. |
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| 2.E.06 | RST Grades 9-12 #5 | Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.  Performance Example:  Students design and/or use a combination of simple machines, analyzing the relationships between concepts involved (such force, friction, weight and other variables) |
| 2.B,02 | 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:  Architecture: Given a set of building parameters, students will design a structure to meet the requirements (will translate text to a visual product, i.e., plans). |
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| 2G.02 | RST Grades 9-10 #9 | Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.  Performance Example:  Students will compare and contrast information presented about Green Energy/ Design, evaluating the best/ most appropriate use of these technologies in a given design. |
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| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | WHST Grades 9-10  #2 (a-f) | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.   1. 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. 2. 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. 3. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. 4. 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. 5. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 6. 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 might explain a design process (2.B.03), describe one of the manufacturing processes (2.E.03), or describe and compare architectural styles of buildings (2.F.01) |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | WHST Grades 9-12 #4 | Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  Performance Example:  Students read an article or a chapter from the textbook and write a summary. |
| 2.C.02 | WHST Grades 9-12 #5 | Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience  Performance Example:  Notes and annotations on finished designs and drawings must be precise and concise |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | 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; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.  Performance Example:  After designing and completing scaled drawings for a small cottage (800-1000 square feet) with kitchen, bath, eating and sleeping areas, students build a scaled model from foam board. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | WHST Grades 9-12 #9 | Draw evidence from informational texts to support analysis, reflection, and research.  Performance Example:   * Students read text and write about their findings, citing information from research. For example, students   cite text when discussing or defending manufacturing processes. As a reflective activity, students cite text when evaluating their complete drawings. |
| 2.A, 2.B,  2.C, 2.D,  2.E, 2.F | 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) 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. |

### [Embedded Mathematics](#_bookmark0)

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| CTE  Learning Standard Number | Math Content Conceptual Category and Domain Code Learning Standard Number | Text of Mathematics Learning Standard |
| 2.B.01 | G-MG MA4 | Use dimensional analysis for unit conversions to confirm that expressions and equations make sense.  Performance Example:  Take an English dimension and divide by 25.4 to obtain metric units |
| 2.B.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:  Given 3D model or drawing, generate 2D views and appropriate cross sections. |
| 2.B.03 | 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:  Given a product, apply the design process to develop new or revised product. Include documentation for each step of process. |
| 2.C.01 | G-CO 12, 13, G-GMD 4, 7G 1, 2 | 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.  G-CO 13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.  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.  7G 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.  7G 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:  Given an object, sketch appropriate views in proportion and/or scale with annotations. |
| 2.BC.02 | 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:  Using an existing drawing, apply appropriate dimensioning standards. |
| 2.C.03 | 7NS 1, (d) | Apply properties of operations as strategies to add and subtract rational numbers.  Performance Example:  Create an as-built drawing based on actual measurements taken. |
| 2.E.01 | NQ 3, (MA.3.a), G-SRT 1 (a, b) | NQ. 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  MA.3.a. 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.  G-SRT 1. Verify experimentally the properties of dilations given by a center and a scale factor:   1. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. 2. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.   Performance Example:  Set parameters for a new drawing based on project requirements with limitations of levelment accuracy |
| 2.D.02 | G-MG 1-3, G-GMD 1,3, GPE 6 | 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).   1. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).   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). |
|  |  | G-GMD 1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri’s principle, and informal limit argu[m](#_bookmark22)ents.  3. Use volume formulas[3](#_bookmark22) for cylinders, pyramids, cones, and spheres to solve problems.  G-GPE 6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  Performance Example:  Modify or create model based on requirements, record CAD data and create output file. |
| 2.E.01 | 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 a flat pattern from its bent up state to find its developed length. |
| 2.E.02 | 7RP 1 | Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½/¼ miles per hour, equivalently 2 miles per hour.  Performance Example:  Using ratio, size full strength weld. |
| 2.E.04 | G-MG 1-3, GMD 1,3,  GPE 6 | 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).  2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).  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).  GMD 1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri’s principle, and informal limit arguments.  3. Use volume formulas[4](#_bookmark23) for cylinders, pyramids, cones, and spheres to solve problems.  GPE 6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  Performance Example:  Create a layout, detail, and assembly drawing for a simple product (pen, depth gauge, space shuttle). |
| 2.E.05 | NRN 3, GC 3,4, NQ 1-3 | NRN 3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.  GC 3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. MA.3.a. Derive the formula for the relationship between the number of sides and sums of the interior and sums of the exterior angles of polygons and apply to the solutions of mathematical and contextual problems.  4. (+) Construct a tangent line from a point outside a given circle to the circle.  NQ 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.  2. Define appropriate quantities for the purpose of descriptive modeling.  3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  MA.3.a. 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:  Create limit dimensions by adding or subtracting real numbers. |
| 2.E.06 | NRN 3 | Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.  Performance Example:  Find the distance a nut travels in one revolution. |
| 2.F.02 | G-MG 1-3, G-GMD 1,3, G-GPE  6 | 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).   1. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). 2. 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).   G-GMD 1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri’s principle, and informal limit argu[m](#_bookmark24)ents.  3. Use volume formulas[5](#_bookmark24) for cylinders, pyramids, cones, and spheres to solve problems.  G-GPE 6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. |

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

#### [Earth and Space Science](#_bookmark0)

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Earth and Space Science Learning Standard |
| 2.G.01 | Matter and Energy in the Earth System, Earth 1.5 (9-  12) | Explain how the revolution of Earth around the Sun and the  inclination of Earth on its axis cause Earth’s seasonal variations (equinoxes and solstices).  Performance Example:  Locate breakfast area on floor plan to maximize morning sun. |
| 2.G.01 | Energy Resources in the Earth System, Earth 2.1 (9-  12) | Recognize, describe, and compare renewable energy resources (e.g., solar, wind, water, and biomass) and nonrenewable energy resources (e.g., fossil fuels, nuclear energy).  Performance Example:  Consider energy needs of a simple single-story residence. |

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

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Physics Learning Standard |
| 2.D.02 | Physical Science - Properties of Matter.2 | Differentiate between volume and mass. Define density.  Performance Example:  Calculate volume, mass, and density of cube. |
| 2.B.03 | Physical Science – Properties of Matter. 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.  Performance Example:  Measure object using imperial and metric units; calculate volume and mass; and compare results. |

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

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| CTE  Learning Standard Number | Subject Area, Topic Heading and  Learning Standard Number | Text of Technology/Engineering Learning Standard |
| 2.B.01 | 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:  Create a drawing using appropriate format and size. Include proper line types, revision, notes, etc. Produce a print to appropriate scale. |
| 2.D.02 | Communications Technologies 3.2, 3.3 | 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).  3.3 Identify and compare communication technologies and system, i.e., audio, visual, printed and mass communications.  Performance Example:  Modify or create model based on requirements, record CAD data, and create output file. |
| 2.E.03 | Manufacturing Technologies 4.4 | Explain basic processes in manufacturing systems, e.g., cutting, shaping, assembling, joining, finishing, quality control, and safety.  Performance Example:  Students create a presentation and assessment questions on one or more processes. |
| 2.F.02 | Construction Technologies | Describe and explain parts of a structure, e.g., foundation, flooring, decking, wall, roofing systems.  Performance Example:  Produce plans for a simple single-story residence. |
| 2.B.02 | Engineering Design 1.3 | Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.  Performance Example:  Given an object, develop a drawing that requires the use of each of the views listed. |
| 2.B.03 | Engineering Design 1.1, 1.5 | 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.  1.5 Interpret plans, diagrams and working drawings in the construction of prototypes or models.  Performance Example:  Given a product, apply the design process to develop new or revised product. Include documentation for each step of process. |
| 2.C.03 | Engineering Design 1.4 | Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m).  Performance Example:  Create an as-built drawing based on actual measurements taken. |
| 2.E.03 | Manufacturing Technologies 7.1 | Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.  Performance Example:  Students create a presentation and assessment questions on one or more processes. |
| 2.F.02 | Construction Technologies 2.4, 2.6 | 2.4 Calculate the resultant force(s) for a combination of live loads and dead loads.  2.6 Recognize the purposes of zoning laws and building codes in the design and use of structures.  Performance Example:  Produce plans for a simple single-story residence. |

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

##### CAD Certifications:

* Solidworks
* Autodesk

##### Drafting certification:

* ADDA (American Design Drafting Association)

##### Safety Credential:

* OSHA 10 hour general industry

##### Resume enhancing items:

* Skills USA participation
* “Live” work experience (in/out of school projects)
* Inclusion of the following included in the Drafting course content: Hand Sketching, Orthographic Projection, Measurement, Geometric Construction, Dimensioning, Tolerancing, Section and Auxiliary Views,

Fasteners, Manufacturing Processes, Architectural Design, Commercial & Residential, Floor Plans, Elevations, Roof Plan and Framing, Foundation Plans, Civil Drawings and Presentation Drawings